CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS
Ninth Annual Session, New York, October 20-24, 1919

OCT 4 1919

ANNUAL SUBSCRIPTION: UNITED STATES AND CANADA, $10.00; FOREIGN, $12.00

Volume XXIX OCTOBER, 1919 Number 4

Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

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PUBLISHERS FOR GREAT BRITAIN: Bailliere, Tindall & Cox, 8 Henrietta St., Covent Garden, London, W. C., England

"Once in a Long While"—

See

Saunders' Announcement

Page 13

Entered as second-class matter May 22, 1913, at the postoffice at Chicago, Ill., under the Act of Congress, March 3, 1897.
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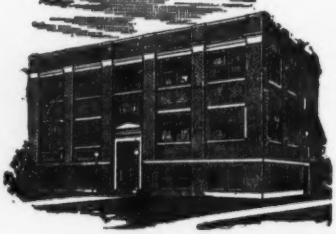

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Plate I. Removal of recurrent carcinoma (third operation), wound left open, for radium.

Plate II. One and a half years after operation, denuded surface entirely covered with new skin grown from the edges, no recurrence up to date, patient gained 30 pounds.

Stereophotograph A. Open operation in recurrent carcinoma of inguinal glands.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIX OCTOBER, 1919 NUMBER 4

INTENTIONAL REMOVAL OF SKIN AND OTHER TISSUES OVERLYING DEEP-SEATED INOPERABLE CANCER, A NECESSITY FOR EFFECTIVE TREATMENT WITH X-RAY OR RADIUM

WITH REPORT OF RELATIVE ABSORPTION OF RAYS BY SKIN, FAT AND MUSCLE, AS COMPARED WITH VARIOUS THICKNESSES OF ALUMINUM

BY EMIL G. BECK, M.D., F.A.C.S., CHICAGO
Surgeon, North Chicago Hospital
AND
G. W. WARNER, A.B., CHICAGO
Of the Ryerson Laboratory, University of Chicago

WHEN confronted with a recurrent carcinoma of the breast or neck, for instance, the surgeon is apt to be too pessimistic in regard to the possibility of helping the patient. Usually the patient is referred to a roentgenologist for radium or X-ray treatment, partly to satisfy the hopes of the patient, who in his despair is happy to believe that something more can be done for him, and partly because we do not yet know definitely the possibilities of radium and X-ray therapy. We hesitate to do anything further surgically because we feel that if the surgeon was not able to eradicate all of the cancerous growth at the first operation, a second operation is apt to be much more difficult and not likely to be as radical as the first one. While recurrent cancer is not a promising field for the surgeon, still it seems to me that we have not yet exhausted all of our efforts in combating this dreadful foe. I have come to the conclusion that even in apparently hopeless cases something more can be done and I have endeavored to work out a method of meeting this problem.

SUGGESTION FOR TREATMENT

It is a well known fact that superficial malignant growths, such as epithelioma, respond readily to X-ray and radium treatment, while deep-seated malignant growths do not. The reason for this is very suggestive: the skin, fat, and subcutaneous tissues which usually overlie deep-seated cancer are strong filters for the penetration of the X-rays, they absorb most of the soft rays from the X-ray tube and allow only the hard rays, which is a small quantity, to penetrate deeply enough to reach the growth. Small quantities of radiation, instead of destroying the cancer-cell are apt to stimulate it to more rapid growth. Therefore it has seemed to me that if the skin and all the overlying tissue and as much of the growth as is feasible is removed and a large area left entirely exposed, and to this field is then applied either the X-ray or radium directly, we may obtain similar results in treating deep-seated carcinoma as are usually obtained in treating superficial growths. In other words, our problem is to convert the deep-seated growth into a superficial one.

[1]Read before the Chicago Surgical Society, December, 1918.

Fig. 1. Showing extent of intentional removal of tissues preparatory to X-ray and radium treatment.

To verify the above hypothesis I began to use this technique in selected cases. I started with a very simple method: Instead of closing the wound after the completion of the operation for cancer of the breast, I allowed the skin edges to retract as much as possible, in order to leave an opening through which the X-ray and the radium treatment might subsequently be allowed to penetrate directly into the cancer bed and destroy any cancer-cells which were inaccessible to surgical removal. I am aware that this has been done by others previously but I have carried the principle further. I have selected recurrent, apparently inoperable cases of deep-seated carcinoma, such as cases of cancer of the axillary and supraclavicular glands subsequent to removal of the breast, and in these selected cases I have removed intentionally large areas of skin, fat, fascia, and muscles and as much of the carcinoma as is consistent with the safety of the operation. The entire area was left exposed for the application of either X-ray or radium treatment (see Fig. 1). During the past two years I have subjected a series of cases to this form of treatment and while it is too early to form definite conclusions, I desire to report the findings and results thus far obtained.

PHYSICAL PROPERTIES OF RADIATION

The physicists teach us that three varieties of rays emanate from radium: the α-ray, β-ray, and γ-ray. The α-rays constitute 91 per cent of all the rays emanated from radium, the β-rays about 7 per cent, the remainder, γ-rays, only about 2 per cent. The γ-rays are very readily absorbed by metal foil or even by the air. Rutherford says that a thickness of 6/1000 aluminum or mica, or even a sheet of ordinary writing paper, is sufficient to absorb completely all the α-rays. Almost all of the β-rays are absorbed in 5 millimeters of aluminum or 1 millimeter of lead. Only the γ-rays will penetrate these filters. The density of tissues depends upon the close packing of the molecules which compose them. In fat, for instance, the molecules are far apart, while in the skin or muscles they are more closely packed, and in metals such as lead or silver, the molecules are extremely dense. The shadows on the photographic plate of these different substances give us an approximate indication of the molecular composition. Lead will produce a very dense shadow, while fat or muscle will give a correspondingly lighter shadow.

For a rough working rule, it may be taken that the thickness of matter required to absorb any type of rays is inversely proportional to the density of the substance. Thus the α-rays have very little effect in the treatment of either superficial or deep-seated growths. The β-rays, however, are about one hundred times as penetrating as the α-rays and the γ-rays are from ten to one hundred times more penetrating than the β-rays. Therefore, it is evident that the α-rays may be entirely ignored as far as the treatment of cancer is concerned. We must depend entirely upon the action of the β- and γ-rays. Are we at present utilizing them to their full extent? We are not. The skin, being the densest of all structures of

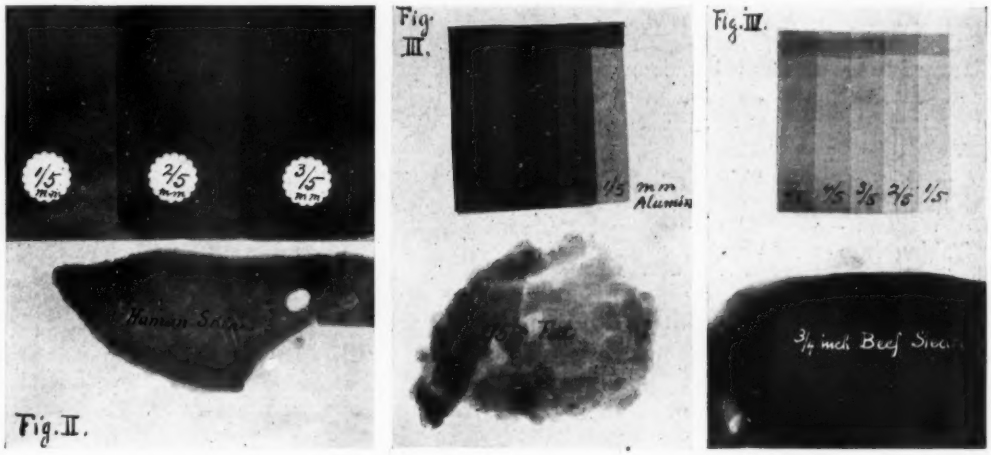


Fig. 2, 3, 4. Compare the density of shadows produced by different thicknesses of aluminum with that of certain thicknesses of tissues, namely, skin, fat, and muscle.

the body, is itself quite an obstacle to the penetration of the X-rays; it produces a shadow on the X-ray plate equal to that of three-fifths of a millimeter of aluminum, because of the arrest of the rays by the skin, and where the underlying tissues, such as muscle, fat, and fascia, absorb still more of the rays, it is likely that very few of the rays ever reach the deep-seated tumor. Thus, we deprive ourselves of the action of the greater quantity of the most effective rays emanating from the radium; namely, the α-rays. Even the γ-rays lose some of their intensity in passing through the skin and subcutaneous tissues.

To determine just how much of the X-ray is absorbed by the skin, fat, and muscle, we have two methods at our disposal: one is the *photographic* method and the other the *electroscopic*. The following experiments have been undertaken by me to determine the quantity of X-ray absorbed by the tissues:

First. A piece of *skin*, free of fat, removed from the knee of a young man, was placed on an X-ray plate and beside the skin were placed three strips of aluminum of different thicknesses; one-fifth, two-fifths, and three-fifths of a millimeter, respectively. Comparing the shadows produced upon the plate by the aluminum and that of the skin, we can approximately estimate the relative amount of rays absorbed by the skin (see Fig. 2). It appears that the skin absorbs about as much as does three-fifths of a millimeter in thickness of aluminum, which is considered by roentgenologists a substantial filter for the rays.

Second. A layer of *fat*, one-half inch in thickness was placed along a series of five aluminum filters, ranging from one-fifth of a millimeter to 1 millimeter in thickness. A roentgenogram for comparison of these two substances was made in a way similar to that in the case of the skin experiment, and it was shown that one-half inch of fat would arrest on the average about as much of the rays as two-fifths of a millimeter of aluminum would filter (Fig. 3).

Third. The same experiment as for fat was made with *muscle* tissue. A piece of beefsteak, three-quarters of an inch in thickness, was placed alongside the filter scale and the shadow produced by the beefsteak was at least three times as dense as that obtained from 1 millimeter of aluminum (Fig. 4). Thus it would appear that three-quarters of an inch of muscle would be capable of absorbing all the β-rays from radium.

The measurements of the absorption of rays by means of the electroscope are more accurate and are now being conducted by G.

W. Warner, A. B., at the Ryerson Laboratory of the University of Chicago. The report of his work is here appended. His experiments show that our photographic measurements are approximately correct; namely, that a great portion of the harder rays are absorbed by the skin, fat, and muscle.

REPORT OF CASES

Taking into consideration these physical characteristics of the rays, I have concluded that in order to have a full measure of the effective X-rays reach the tumor, we must remove the obstruction to their passage; namely, skin, muscle, and as much of the tumor as possible. The procedure will be best understood by the demonstration of cases, because the operation must of necessity be different in each case. For illustration I shall cite several cases from a larger series in which this treatment has been tried. We must bear in mind that we are attempting the almost impossible and cannot expect that a magic cure will follow in miraculous fashion. If we can improve only in a small degree upon previous methods, we are taking a step in the right direction, which may finally lead to fruitful results.

The method is based on scientific principles, and while the number of cases thus far treated is not sufficiently large to draw definite conclusions, the results are encouraging enough (considering the hopelessness of the cases) to justify its application. The patients are usually perfectly willing to undergo one more operation, because they have lost all hope of getting well.

What becomes of this large denuded surface after the growth has apparently disappeared? The skin will gradually grow from the edges of the wound until it covers the entire surface. The growth of epithelium is accelerated by the aid of adhesive plaster.[1] The growth of skin over the cancer area is proof in itself that the cancerous tissue has been eliminated, because healthy epithelial cells will not grow over cancer tissue. I have observed in the cases I have treated that skin will grow over large surfaces which formerly contained masses of cancerous tissue. Whether there will be metastatic tumors in other parts of the body following this treatment is an unsolved question. It is likely that there will be. The susceptibility to cancer recurrence in what is called a cancer individual may still remain even though the growth in a particular region be destroyed. It has been stated by some observers that subsequent to the X-ray treatment changes take place in the entire body, and the changes immunize the patient against recurrence. This is too extensive a question to be discussed in this paper.

The following cases will serve as illustrations of this method of treatment.

CASE 1. Recurrent carcinoma of the breast, wound left exposed at last operation. Mrs. S. S. was operated upon in August, 1916, for a tumor of the breast. The breast was not removed. The microscopic specimen of the tumor showed carcinoma. Therefore it was decided to remove the breast and axillary glands, which I did on August 8, 1916.

Instead of closing the entire wound, a window about 4 by 4 inches was left exposed for the purpose of treating the underlying tissues with X-ray. The treatment was carried on for 3 months, during which time the skin gradually grew from the edges and finally covered the entire denuded area, as shown in Figures 5, 6, and 7.

The patient had no recurrence in the breast, but returned in September, 1917, complaining of a con-

[1] Method described in Ann. Surg., 1919, April.

Stereophotograph B.[1] A man 58, first radical operation for carcinoma of the submaxillary gland in 1919. Recurrence took place with great rapidity, so that it involved the recurrent laryngeal nerve, producing hoarseness and inability to open his mouth. Case pronounced inoperable by competent surgeons. This stereo illustrates the extent of the intentional removal of tissues during which the jugular vein was excised. Radium and X-ray treatments are being carried out at present.

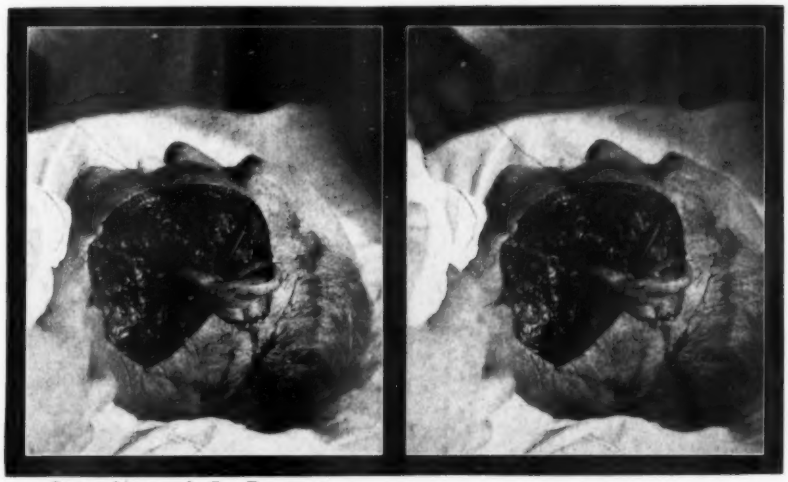
Stereophotograph C. A man of 66, who had a very extensive carcinoma involving the middle ear and mastoid region and entire neck down to the supraclavicular region. This stereo shows the extent of the operation, excising all the carcinomatous tissues surrounding the ear. The lower part of the exposed ear was separated from the bone and later on sutured to the wound in order to preserve the ear.

The entire surface was left exposed for radium and X-ray treatment.

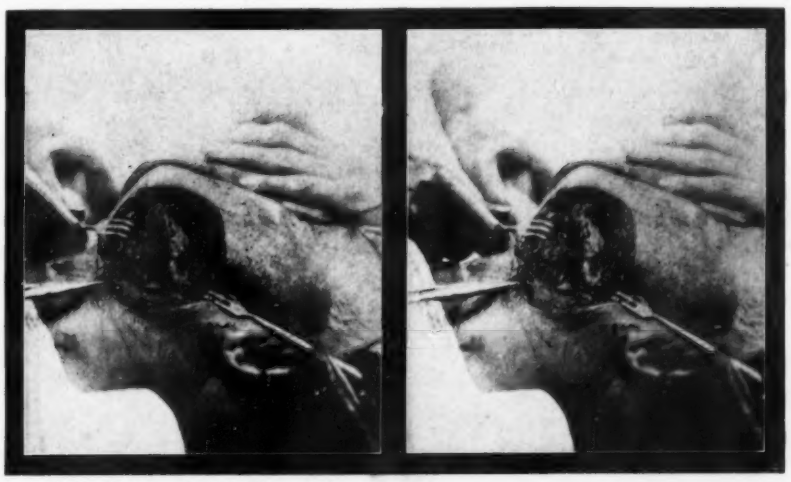
Stereophotograph D. A man 53 years of age presented himself with a large recurrent carcinoma of the submaxillary gland, involving the glands of the neck. Primary operation performed in Ohio. This stereo illustrates the total excision and depth of the carcinoma, exposing the entire transverse ramus of the jaw. Patient is being treated with radium and X-ray.

[1] These stereophotographs should be viewed through a stereoscope.

Stereophotograph B. Recurrent carcinoma of submaxillary gland.



Stereophotograph C. Recurrent carcinoma of middle ear and neck.



Stereophotograph D. Recurrent carcinoma of submaxillary gland.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 5. Denuded surface left open for subsequent application of radium and X-ray.

Fig. 6. Granulating surface gradually being replaced by skin growing from the edges, after prolonged treatment with X-ray.

Fig. 7. Dry surface one year subsequent to operation.

tinued headache in the frontal region, loss of appetite, but no loss of weight. Whether this headache was a sign of metastasis in the brain cannot be stated, as the patient would not consent to any exploration, and we lost track of her.

CASE 2. Carcinoma of jaw—open method for deep therapy. H. H., age 60, developed a carcinoma of the lower left lip, which was removed in July, 1915. The wound healed. In 1917 he noticed a lump the size of a hazelnut growing inside of his lip in the same region. Within two months the glands on the left side of the neck began to enlarge. A radical operation was performed in October, 1917, with resection of the submaxillary gland and of all the lymphatics on that side, as well as a resection of the tumor in the mouth and part of the lip. A large amount of skin overlying the maxillary bone was removed and a flap of skin was shifted over to cover the defect (Fig. 8, insert). Healing took place within two months, as shown in Figure 8.

In July, 1918, recurrence took place in the lower maxillary bone (Fig. 9). Another radical operation was performed, this time resecting the lower part of the transverse ramus of the lower jaw and all the overlying tissue, and the ascending ramus was curetted. The wound was not closed. Radium and X-ray treatments were applied directly into the diseased tissue (Fig. 10).

Under the treatment healing took place rapidly, the skin gradually grew over the exposed area (Fig. 11). The patient remained perfectly well until April, 1919, when he developed severe headache and earache. It was uncertain as to whether there was any recurrence high up under the cranium but very likely there was. There was no recurrence, however, in the neck or at the seat of the operation, which was treated by the exposed method. The patient is still under observation. End-result is uncertain.

CASE 3. Recurrent cancer of breast, supraclavicular excavation. Dr. J. C., age 48, married; 1 healthy child. The patient developed carcinoma of the left breast in June, 1918. Although it was growing rapidly and she was losing in weight, she refused the removal of the breast until September, 1918, when all axillary glands were involved and a noticeable mass and induration were felt above the clavicle. The breast was removed in September, 1918, with radical removal of all glands and muscles below the clavicle. Daily X-ray treatment was given after the operation to reduce the involvement in the supraclavicular region, but instead of a reduction the growth increased in size and the arm became swollen. She could not raise it above 90 degrees (Fig. 12).

I decided then to remove the skin, fat, and all cancerous involvement above the clavicle within reach. This was done on January 21, 1919. An area of 3 inches in width and 5 inches in length was denuded, the clavicle was entirely exposed, and as much diseased tissue above the clavicle as was feasible was extirpated; no attempt was made to close the wound (Fig. 13).

Through the wound daily X-ray treatments for one month were given and radium was applied once a week for 12 hours. The crater gradually filled up with what appeared to be normal tissue. February 1, 1919, we began the application of adhesive plaster along the edges of the wound, for the purpose of favoring regeneration of the skin. This proved satisfactory and at present the entire wound is covered with dry skin and no recurrence of the can-

Fig. 8. Plastic operation subsequent to removal of carcinoma of the neck and lower jaw. Insert shows complete healing four weeks later.
Fig. 9. Recurrence about six months later.

cer has as yet taken place. The patient has been gaining at the rate of 1 to 2 pounds a week since the last operation (Fig. 14).

CASE 4. Cancer of neck with recurrence after two operations, third operation with open wound proved effective. Mr. A. L. M., 54 years old, developed a cancer of the lip early in 1916. The same was excised and for several months there was no recurrence. In November, 1916, several glands in the region of the sternocleidomastoid were found and a radical excision of the same was done. Recurrence took place after this operation but the patient would not submit to a more radical procedure until the tumor was of considerable size, when in March, 1918, a very radical operation was performed by Dr. Carl Beck. X-ray treatment and also radium was then applied almost daily over the sutured wounds but recurrence took place as quickly as before, and within 3 months there was a tumor the size of an orange in the submaxillary region, the original seat of the trouble. In this desperate condition the patient presented himself to me and I proposed the open method of treatment, which was carried out as follows: A circular flap, with the base pointing to the lower jaw was lifted up and all of the tumor mass that could possibly be removed

Fig. 10. Open operation, removing muscle and part of the maxillary bone. Radium inserted into the ramus of the jaw.
Fig. 11. Skin gradually covering the denuded surface, lip preserved.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 12. Recurrent carcinoma of the breast in the supraclavicular region. Œdema of arm.

Fig. 13. Removal of skin, fat, muscles, and supraclavicular involvement, wound left open for treatment.

Fig. 14. Five months later, wound entirely covered with skin; patient gained 20 pounds, perfect motion in arm. No recurrence up to date.

was eliminated. The skin flap was then pushed underneath the inner ramus of the jaw and kept there by gauze packing. This left the wound entirely exposed (Plate I).

Into the depth of this wound 10 milligrams of radium element was inserted for 24 hours. This was repeated every week, besides the daily exposure of the wound to the X-ray. The patient began to gain in weight rapidly, 20 pounds to date, the skin began to grow into the wound by the aid of adhesive plaster, and now, more than a year later, the patient is in perfect health, without a sign of recurrence (Plate II).

We have done even more extensive operations upon three other cases of recurrent carcinoma of the jaw or the submaxillary gland, but it is still too early to make a report as to the therapeutic results. At present I will simply include photographs to illustrate to what extent we should go in removing the overlying tissues in cases of this kind. A final report of the entire series of cases will be made when sufficient time has elapsed to permit us to judge more or less the therapeutic effects of this treatment.

Stereophotographs B, C, and D show the extent of the removal of skin, fat, fascia, and glandular structures and as much of the tumor as feasible. A short history and description of the operation is found in the legends for these illustrations.

Another illustration of the extent to which we may proceed in resecting recurrent carcinoma in the inguinal region is shown in the colored Lumière stereophotograph A.

In this case there was a most extensive involvement of the inguinal glands, the lower part of the abdominal muscles and the glands beneath Poupart's ligament, subsequent to a primary carcinoma of the scrotum. The deep vessels were involved also. All the tissues overlying the tumor and as much of the tumor, including Poupart's ligament, as possible were removed in January, 1919, and the large surface shown in the picture left for subsequent radium and X-ray treatment. Rapid improvement followed first and the tumor mass has almost disappeared, so that patient was able to travel to Detroit to be presented before the Western Roentgen-Ray Society. Later metastatic tumors appeared in the right inguinal region, which were excised early enough to prevent involvement of the deeper structures. Unfortunately the patient had a severe hæmorrhage from an erosion of the femoral vein on the left side, the first involved, which caused sudden death.

The subject is here treated mainly from the standpoint of the surgeon and not from that of the roentgenologist. Thus the points in the technique of the application of the X-rays, etc., are omitted. This important part of the work is being worked out by Dr. Paul Eisen, roentgenologist at the North Chicago Hospital, who has treated all of my cases and who will in due time publish his observations as well as those I have had in the application of radium.

The roentgenologist is handicapped when such cases are referred to him for treatment, for the surgeon has closed for him the door to success by suturing the wound over the area to be treated. When the surgeon realizes

that the full exposure of the cancer bed is necessary to avoid recurrence, he will disregard the cosmetic effect and prepare the field for efficient roentgen treatment.

I present this subject in this immature state merely that others may try it and help perfect the surgical as well as the roentgen technique. It certainly can do little harm to these poor individuals who have nothing but misery and death to look forward to.

RELATIVE ABSORPTION OF RAYS BY SKIN, FAT, AND MUSCLE, AS COMPARED WITH VARIOUS THICKNESSES OF ALUMINUM

By G. W. WARNER, A.B.

A HYDROGEN tube with tungsten target was used, excitation being produced by a transformer and rotary rectifier (Victor). The absorption was measured by an ionization method. The distances of 16 and 32 inches refer to the distances from the target to the window of the ionization chamber. The numbers are percentages of the total incident rays absorbed; e.g., one aluminum screen absorbed approximately 25 per cent of all the rays falling upon it in the conditions given in Table I. The aluminum screens were of standard type but varied from 0.20 to 0.23 millimeters in thickness. Since the time of exposure was of necessity very short and because the effects from equal short intervals of time are not equal, due to the variations in the primary current, no attempt was made to keep the time intervals constant, but in general it was somewhat longer for the 32-inch distance than for the 16-inch distance.

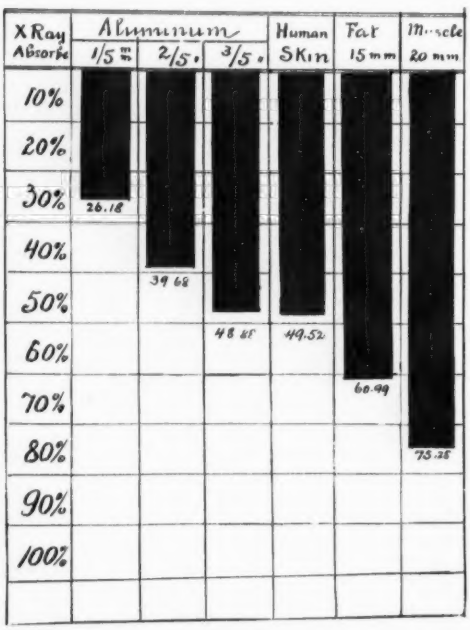


Chart I. Absorption of X-rays by skin, fat, and muscle, as compared with 1/5, 2/5, and 3/5 millimeters of aluminum.

In Table I two sets of data were taken for the 16-inch distance for each absorbing substance. A comparison of these results shows that the percentage of variation is in all cases less than 1. Comparing the results for the two distances shows that for short distances there is practically no difference in the percentage of absorption, hence in the remainder of the work the 32-inch distance was used.

In Table II the same absorbing substances were used as in Table I but with the addition of three other substances. The heterogeneous rays were obtained with the same conditions as before except that the voltage and consequently the current through the tube were increased slightly. The medium hard rays were obtained by screening out the soft rays by interposing a piece of plate glass between the tube and the ionization chambers.

The great variation in the two samples of skin is easily accounted for by the fact that the first sample was much thicker and of more uniform thickness than the second.

TABLE I

Absorbing Substance	Conditions: Victor H. Tube, Tungsten target, Spark 5 inches, Current 1.2 milliamperes. 16 inches	32 inches
One aluminum screen	25.06 25.18	24.07
Two aluminum screens	37.48 37.14	37.18
Three aluminum screens	45.40 45.04	45.06
First sample skin	46.45 45.65	46.48

TABLE II

Absorbing Substance	Conditions: Victor H. Tube, Tungsten target, Spark 5.5 inches, Current 1.6 milliamperes. Distance, 32 inches. Heterogeneous	Medium Hard
One aluminum screen	26.18	
Two aluminum screens	39.88	
Three aluminum screens	48.88	
First sample skin	49.32	
Second sample skin	17.91	8.08
Fat 15 millimeters thick	60.99	31.49
Beef 20 millimeters thick	75.25	42.88

The slight increase in percentage absorption with increased voltage would at first seem to indicate that the absorption is greater for hard rays than for soft ones; but since when all the soft rays are screened out by interposing the plate glass the percentage absorption is cut down approximately half, the explanation is no doubt that while increased voltage did produce some harder rays it also produced a proportionally greater number of soft rays, thus increasing the percentage absorption for the heterogeneous beam. The very great decrease in percentage absorption for the harder rays seems to be a plain indication that the fleshy tissues are quite transparent to hard rays.

It is usually unwise to attempt to draw a conclusion from incomplete data but it seems safe in this case to predict that a few centimeters of body tissues would act effectively as a screen for nearly all the soft rays, but would be quite transparent to hard rays. Hence if it be the soft rays that are valuable in therapeutics, the removal of parts overlying the diseased organ is quite essential; but if hard rays are the valuable ones, then removal of the overlying tissues seems unnecessary.

Chart I illustrates the comparative figures of ray absorption by various tissues.

CUTTING THE SENSORY ROOT OF THE GASSERIAN GANGLION FOR THE RELIEF OF TRIFACIAL NEURALGIA[1]

By A. W. ADSON, M.D., Rochester, Minnesota
From the Surgical Section on Neurology, Mayo Clinic

THE treatment of trifacial neuralgia has varied from the use of simple counter-irritants to the most radical procedure, namely, ganglionectomy. The methods now employed are injection of alcohol into the peripheral branches of the ganglion, avulsion of the peripheral branches, and the division of the posterior root, known as the physiologic extirpation of the ganglion.

The disease has no known etiology. Sir Victor Horsley has stated that trifacial neuralgia is possibly caused by dental infection, resulting in ascending neuritis. This, however, has been objected to by numerous physicians on the grounds that if the condition were ascending neuritis, there would be a definite anæsthesia as well as a motor paralysis in the branches involved. Frazier states that its etiology may be a sclerotic lesion of the ganglion, while Dana ascribes the probable cause to degenerative changes in the ganglion and nerves which lead to neuritis. These suggestions are at least hints toward solving the problem of the etiology.

Patrick, in his reviews, has given an excellent résumé of the symptomatology of trifacial neuralgia. He calls attention to the fact that the disease is about equally divided among both sexes, that there is only one type, that it usually occurs in middle life or after, but that it may occur in very young persons. He reports a case in which the symptoms began when the patient was 7 years, and three cases in which the patient was 75 years. Patrick's deductions are practically as follows: There are no predisposing factors, and while some patients are neurotic others are not. The disease is not hereditary although there are cases on record in which several members of the same family were afflicted. The neuralgia affects the infra-orbital division first in the order of frequency, then the mandibular, and lastly the ophthalmic. Pain, as experienced by patients, is described as, "shooting, stabbing, jabbing, flash-like, darting and zigzag lightning of the face"; it is, as a rule, of short duration, and not a continuous, dull, aching type that is usually brought on by irritation, such as eating or drinking of hot or cold foods and liquids, talking, exposure to sudden drafts or washing of the face and teeth. The patients complain of certain areas of the face, the trigger zones, being more sensitive than other parts of the face. Patrick also states that the disease is generally a chronic one, that he has seen no spontaneous cures, that quiescent periods may last from 4 to 6 months, that seasons have no bearing on the causation of the attacks, and, that during the attacks pain is usually quiescent at night. The condition has a definite symptomatology and does not simulate migraine nor pain that comes from sinus infection or dental caries. The true case of trifacial neuralgia has never been relieved by sinus drainage nor by the removal of teeth.

The first radical treatment was administered for the condition by Rose in April, 1890, when he removed the gasserian ganglion, but on account of the serious bleeding and the complications that developed, he was compelled to abandon this procedure. In 1898, Hutchinson advised a partial resection of the ganglion. He removed two-thirds of the ganglion and resected the second and third branches, saving the ophthalmic. His preference for this operation was on the grounds that it is not so serious as a complete ganglionectomy, that it does not produce anæsthesia of the eye, thus avoiding conjunctivitis and trophic interstitial keratitis. This operation is at best attended with considerable bleeding and does not offer any relief for neuralgia of the ophthalmic branch. Pitres and Verger in 1902 and Schloesser in 1903 described methods of injecting the peripheral branches of the fifth nerve with alcohol for

[1] Submitted for publication June 7, 1919.

the relief of trifacial neuralgia. Haertel described the technique for injecting the gasserian ganglion with alcohol, and since then numerous articles have appeared on the subject. The alcohol treatment is definitely indicated in a certain group of cases, assisting in the diagnosis by giving relief in the true trifacial neuralgia and relieving temporarily patients who are poor operative risks and patients who are being prepared for the radical operation. Alcohol injection of the peripheral branches is not satisfactory, as a routine treatment because the condition offers only palliative relief; the average time of relief afforded is 9 months. The injection of the ganglion is a rather difficult procedure; extreme care must be exercised not to inject the brain stem. While the effects produced are more lasting than those from the injection of the peripheral branches, they are associated with more serious complications than is the present radical treatment of the posterior root. Haertel reported eye complications in 25 per cent of his series. Avulsion or torsion of the peripheral branches is practised by a number of physicians, but the relief is generally of shorter duration than the relief afforded by the injection of alcohol. Beckman stated that the average time of relief obtained from the injection of alcohol is 8.4 months. While the operation is not attended with serious complications, it is very difficult to secure complete relief, and it is difficult to repeat it.

Division of the root, or the physiologic extirpation of the ganglion, appears to be the operation of choice in the radical treatment of trifacial neuralgia. Attention was called to this treatment by Spiller in 1898, and by Frazier in 1901. In their experimental work they proved that if the fibers posterior to the ganglion are divided, regeneration never occurs in the brain stem. Following Frazier's and Spiller's work Van Gehuchten presented his investigation, which corroborated their work, and in 1918 Frazier reported a series of cases in which this technique had been employed with gratifying results.

The complications attending the various ganglion operations have been serious hæmorrhages, paralysis of the third, fourth, and sixth cranial nerves, frequent paralysis of the frontal branch of the seventh nerve with occasional involvement of the whole seventh nerve, conjunctivitis, and trophic interstitial keratitis. The bleeding has been due to inability to control the venous hæmorrhage, with occasional injury to the middle meningeal, but as better exposure of the ganglion has been obtained by the use of specially adapted retractors with lights, the bleeding can be controlled with very little difficulty. Frazier has called attention to the use of small pledgets of cotton made by cutting dental rolls into small cylinders. These are of great value in elevating the dura from the bone and can be used as tampons to control small venous oozing along the floor of the middle fossa; either the middle meningeal may be ligated or the foramen spinosum may be plugged with wax. The paralysis of the third, fourth, and sixth cranial nerves has been avoided by the use of the ganglion retractor, which keeps the dura on tension and does not rest on the cavernous sinus or ocular nerves. The small dental packs also assist in avoiding this complication as they can be placed directly over the bleeding point, thus dispensing with a gauze pack, which occasionally produces paralysis.

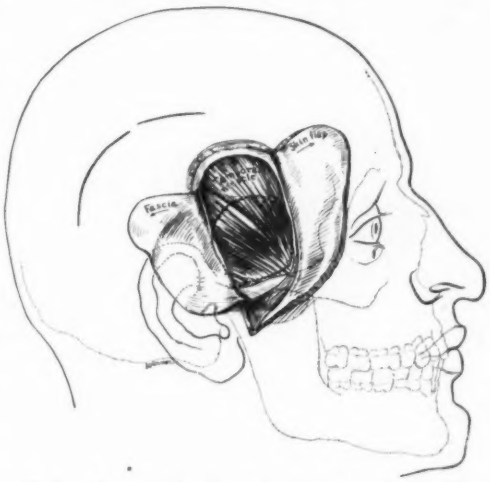


Fig. 1. Diagram showing the approach to the ganglion. The skin flap is turned forward, the fascia flap backward, and the temporal muscle is split in the direction of its fibers. The decompression following is indicated by the heavy dotted line.

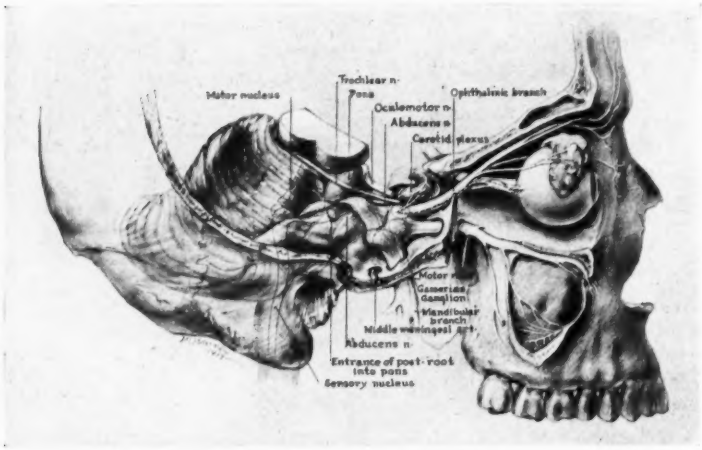


Fig. 2. The relation of the ganglion to its surrounding structures and the communications between the carotid plexus and the ophthalmic portion of the ganglion.

The frontal branch of the seventh nerve was frequently injured in making the Hartley-Krause incision, but it is rarely injured in the incision described by Frazier, which is within the hair-line.

In operating in 10 cases of trifacial neuralgia in 1917, and in 28 cases in 1918, at the Mayo Clinic, two complications have attended the technique suggested by Frazier and Spiller: the occasional paralysis of the seventh nerve, and the trophic interstitial keratitis. When seventh nerve palsy occurs, it is accompanied by a lagophthalmos which, in turn, permits undue exposure and dryness of the cornea, resulting in abrasions and the formation of trophic ulcers. Interstitial keratitis may occur independently of paralysis of the seventh nerve; it is very troublesome and may result in the formation of an opaque cornea. If these complications could be avoided in the technique, the operation could be recommended without any hesitancy to patients suffering with trifacial neuralgia.

In an investigation of the probable factors involved in the causation of seventh nerve palsy, it was found (Hutchinson) that the seventh nerve paralysis might occur as the result of detachment of the dura from the petrous bone, thus allowing the blood to enter into the small openings leading into the aqueduct of Fallopius; when the paralysis occurs, it occurs immediately. It may be only slight at first, but it becomes complete within a day or two, as in one of our patients. It was present immediately after the operation, progressed until complete, and then subsided, very slowly, during 6 months. The condition was also attended with trophic interstitial keratitis. A notation was made at the time of operation to the effect that the dura had been stripped along the ridge of the petrous bone. I have had four patients with a seventh nerve paralysis, however, in whom the dura was not stripped from the petrous bone. The technique employed was that suggested by Frazier and Spiller, in which the root was avulsed with a blunt hook. All of these patients were free from facial palsy until after the fifth day, when it came on gradually, became complete, remained for about 6 weeks, and then gradually disappeared. I am unable to say definitely just what the causal factors were, but, on avulsing the ganglion roots at postmortem, considerable trauma in the pons at the point of exit of the posterior root of the gasserian ganglion was noted. It seems probable that the cause of occasional seventh nerve paralysis is trauma resulting in small hæmhorrages and œdema of the pons and of the brain stem. This is further verified by the results obtained

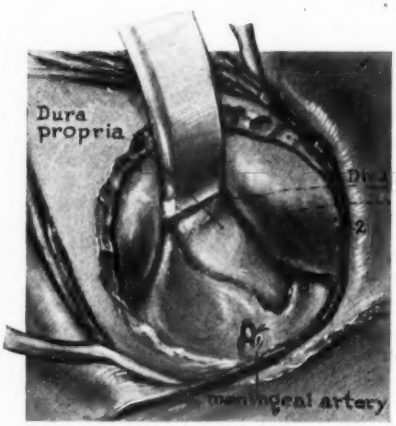


Fig. 3. Exposure of the third branch of the right trigeminal nerve, gasserian ganglion and ligated middle meningeal artery.

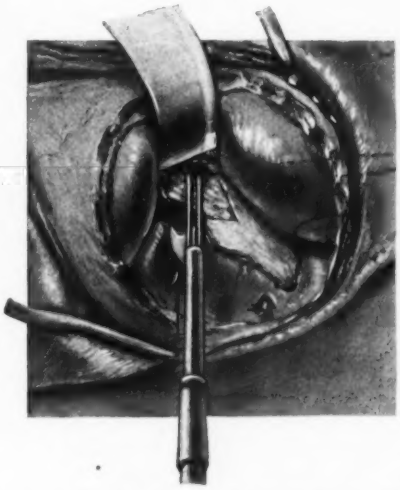


Fig. 4. Posterior root brought into view after the division of the dura propria preparatory to cutting the posterior fibers.

when the posterior root is cut and not avulsed. No seventh nerve paralysis occurred in 26 successive cases from January to August 1919, since this change was made in the technique.

Budge's experimental work on dogs shows that the pupils of the eye will contract when the branches of the trigeminal nerve are divided peripheral to the ganglion but will only slightly contract when divided proximal to it.

Bernard found that the pupil contracted and later dilated, after the division of the trigeminus, but never attained the same size as the pupil on the other side. These phenomena occur after central division as well as after peripheral division of the fifth nerve.

Spiller says it is probable that sympathetic fibers pass to the eye after entering the trigeminal nerve through the gasserian ganglion and, as in the division of the sensory root they

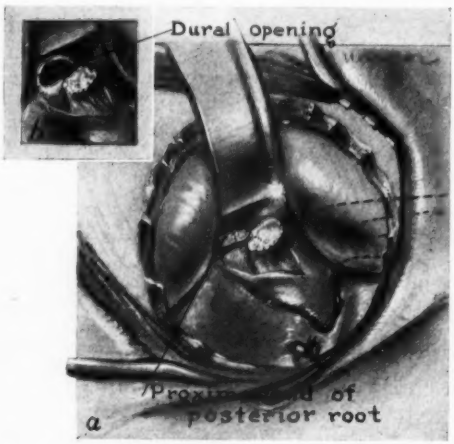


Fig. 5. *a*. Cut ends of the posterior root of the gasserian ganglion. *b*. Dural foramen over petrous portion of temporal bone through which the proximal fibers of the posterior root have dropped into the posterior fossa.

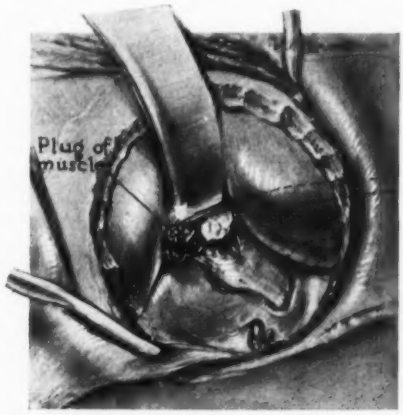


Fig. 6. Inserting pledget of muscle into dural foramen between severed ends of the posterior root.

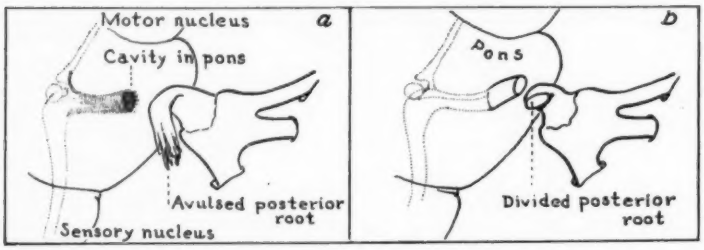


Fig. 7. *a*. Indicates the trauma produced within the pons by avulsion. *b*. Division of the posterior root by cutting without causing trauma of the pons.

are not injured, the danger of ocular disturbance by this operation is lessened. The trophic influence of the gasserian ganglion on the eye may possibly depend on the integrity of these sympathetic fibers.

In our observations, it was found that whenever trophic interstitial keratitis occurred, one of two things happened at the time of operation; either the dura propria had been split so that the ganglion was greatly exposed or it was necessary to insert a large pack to control bleeding, thus causing pressure on the ganglion. It was noted also that if only the posterior margin and root were exposed, there was never any immediate keratitis. From experimental work it is evident that sympathetic fibers from the carotid plexus in dogs pass through the ganglion into the ophthalmic branch. It is difficult to state just what communications take place in man, but the pupillary phenomenon, as seen in dogs, does not occur in man. I believe, however, that sympathetic fibers play an important part in the trophic supply of the cornea, or that this function is controlled by the ganglion cells of the ophthalmic division, which, if not injured during the operation, will protect the cornea against ordinary irritations. The ganglion cells or sympathetic fibers remain uninjured if the dura is not elevated over the ganglion.

OPERATION

The patient is placed in a semi-erect position with the head on a special headrest which may be raised or lowered to the position desired. A general anæsthetic is used. The anterior limb of the question mark incision over the temporal region and down in front of the ear to the zygoma begins 3 centimeters posterior to the external angle of the orbit and 3 centimeters above a line drawn parallel with the zygoma. The skin flap is turned forward and the fascial flap covering the temporal muscle is turned backward, both being carried down to the zygoma. The temporal muscle is split and the skull exposed by a mastoid retractor. A subtemporal decompression is done, and an area of bone about 3 centimeters by 3 centimeters is removed. The dura is gently elevated from the middle fossa until the meningeal artery, which we prefer to ligate, is exposed. The foramen is plugged with bone wax followed by further elevation of the dura until the posterior margin of the third branch appears. Dissection is then carried posteriorly and inward, exposing only the posterior margin of the ganglion; the dura propria is not opened until the region of the posterior root is reached, thus injury of the ganglion is avoided, particularly of the inner portion, the cells controlling the ophthalmic branch. Before the dura propria is opened over the posterior root, all bleeding is controlled. The dura covering the brain is held under gentle tension and the cavity is well illuminated by means of the ganglion retractor. After the dura has been opened, the fibers of the posterior root are gently exposed and slightly elevated, and the guillotine knife is slipped over the fibers which are to be cut, thus avoiding any trauma of the pons or brain stem. The cavernous sinus is rarely injured, inasmuch as all of the anatomical marks may be seen clearly. The fibers of the posterior root just above the ganglion are

turned down over the ganglion while the proximal fibers are pushed back into the posterior fossa. A small pledget of muscle is inserted into the dural foramen as a plug. This assists in making a barrier between the severed ends and prevents the extensive loss of cerebrospinal fluid that usually follows when the patient recovers from the anæsthetic. If there is any danger of bleeding, it is well to insert a narrow strip of iodoform gauze, and remove it on the third day. The muscle and fascia are closed with interrupted sutures of chromic catgut No.1. The skin is closed with interrupted sutures of silk, which are removed on the fifth day. During the operation, the eyelid is closed with adhesive, which is replaced by a Buller's shield before the patient leaves the operating room. The shield is worn for a week or ten days and subsequently is exchanged for close fitting automobile goggles, to be used whenever the patient is exposed to wind or dust. In addition to wearing goggles, we advise irrigations twice daily with 2 per cent boric acid solution.

The principles of the physiologic extirpation of the ganglion laid down by Spiller and Frazier have been carried out in the foregoing technique, except that the posterior root has been exposed without injury to the ganglion and particularly the cells supplying the ophthalmic branch, thus decreasing the frequency of trophic interstitial keratitis, and the posterior root is cut instead of avulsed, in this manner avoiding the occasional seventh nerve paralysis.

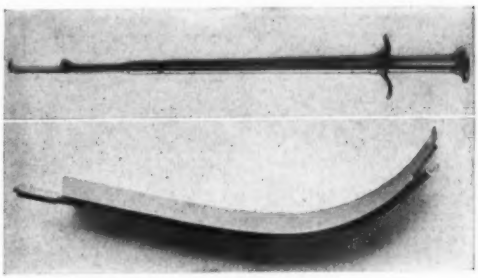


Fig. 8. (above). Guillotine knife.
Fig. 9. Ganglion retractor.

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SCAR-TISSUE TUMORS OCCURRING ON THE MUCOUS MEMBRANE OF THE LOWER LIP

By JOSEPH COLT BLOODGOOD, M.D., F.A.C.S., Baltimore

WE are all familiar with the ordinary keloid which may form in any scar, whether the wound heals by first intention or by granulation. We know that this keloid is observed more frequently in the colored race and in children in the white race, and is perhaps more frequent in females of the white race than in males.

Microscopically this keloid growth is composed largely of spindle cells and fibroblasts; very cellular areas are not conspicuous. It is covered with epidermis in which the papillary epithelial body is small, and there are no hair follicles or glands. The thin epidermal covering of the subepidermal scar rarely ulcerates unless subjected to trauma. Then a chronic ulcer develops which is very slow in healing. In cases of this kind the microscopic section shows a surface of cellular granulation tissue. Although theoretically one would expect the development of sarcoma in such an area, or carcinoma when there is an ulcer, I have observed neither in a long experience.

The life history of the keloid in scars is not unlike ossifying myositis. This also may be looked upon as a scar-tissue tumor, the original wound being a laceration of muscle associated with hæmatoma, and in the surrounding granulation tissue bone formation takes place. The intramuscular tumor reaches a certain size, then remains quiescent, then gradually, partially or, in some instances, completely disappears. The majority of surgeons and pathologists are now familiar with this benign muscle lesion, although formerly it was frequently explored under the diagnosis of sarcoma, and in some cases amputations performed.

Other types of scar tumors or granulation-tissue tumors will not be discussed in this article, as I wish to call special attention to an infrequent type which, my records show, have usually been diagnosed clinically, and often pathologically, *recurrent carcinoma*, both by the surgeon and pathologist.

This benign scar-tissue tumor occurs on the mucous membrane of the lower lip. The patients give a history of the removal of a small mucous membrane, or subepidermal tumor. The growth has been removed either with the knife or some caustic. In the majority of cases the tissue removed has not been studied microscopically. Now, when an induration appears in the scar which has the feel of a recurrent carcinoma, there is a second operation, but the scar-tissue tumor always recurs. Now, if a diagnosis of carcinoma is made, the indicated operation would be mutilating.

The clinical and pathological evidence which I have been able to collect since 1914 demonstrates that this is a "keloid growth," and the best results are obtained when it is left alone. These observations also emphasize the vital importance to the patient that these little, apparently innocent primary tumors should not only be studied with the microscope, but the original sections and tissues should be preserved, because if the scar-tissue tumor does develop, the knowledge that the primary growth was benign allows one to be certain that the induration in the scar is not due to the local recurrence of a malignant tumor. When this evidence is not obtainable, the diagnosis is much more difficult, and in some cases the scar tumor must be excised for microscopic study.

When we consider the scar-tissue tumors of the mucous membrane of the lower lip, the following evidence based upon a large number of cases over a period of twenty-five years is helpful.

Primary carcinoma of the *mucous membrane* of the lower lip is rare. The position of onset of carcinoma of the lower lip is usually at the *muco-cutaneous* border. When this local lesion is excised as a V-shaped piece of tissue and the wound closed, I have never observed the keloid or scar-tissue tumor which I am about to describe. If an induration appears in such a scar, the probabilities are that it is a

recurrence. But local recurrence after the proper complete excision of a primary carcinoma of the lower lip is unusual in the hands of good surgeons.

However, when we excise a piece of the mucous membrane with the submucous glands for a benign tumor of the mucous membrane or a benign cyst of the submucous glands, a little keloid growth is not an infrequent sequel. Associated with the induration in the scar there is always the sensation of tension and discomfort and the swelling of the lip in and about the scar varies. This change in the size of the palpable area is characteristic. The patients are always apprehensive that the condition is malignant, and as a rule their mental discomfort is greater than the local.

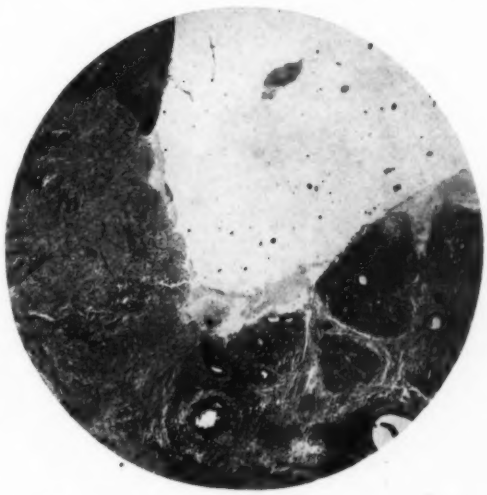


Fig. 1. Case 1. Pathol. No. 16407-x. Scar-tissue tumor of mucous membrane of lower lip. Low power photomicrograph of section of tissue removed at second operation. Hypertrophied epidermis, cellular scar tissue, mucous glands surrounded and invaded by granulation tissue.

CASE 1. Pathological No. 16407 Mr. R. W. Observed in October, 1914. Well, April, 1919, four and one-half years.

This patient was a white male, aged 38. When I saw him in October, 1914, there was an indurated scar on the mucous membrane of the right side of the lower lip extending from the muco-cutaneous border down to within 1 centimeter of the gum. About one year ago he observed a white patch on the mucous membrane in the area of the present scar. This apparently was a patch of leucoplakia. After it had been present 5 months, it was removed with some caustic. There formed almost immediately in this scar an area of induration which was painful and the swelling of the lip varied in size. It had been present then about 6 months. Although I felt that the condition was benign, I had no way of ascertaining the nature of the original local lesion, except from the history. On October 22, 1914, under novocaine, I excised the scar with an area of normal mucous membrane, but did not cut through the skin. The microscopic study of this tissue showed no evidence of carcinoma, but a granulation-tissue tumor somewhat like an ordinary keloid.

Figure 1 (low power) shows a bit of hypertrophied mucous membrane, the cellular scar tissue, and the scar tissue surrounding the mucous glands. Figure 2 shows only the scar-tissue tumor. Figure 3 (high power) shows that the tumor is composed largely of spindle cells and fibroblasts, but there is a number of different types of round cells, many of them of endothelial type, and remains of what appeared to be degenerated acini of mucous glands.

Although the wound healed by first intention, the induration in the scar immediately reformed, the patient complained of intense discomfort and was very apprehensive. Not knowing as much about these scar-tissue tumors as I do now, I was persuaded to operate again in about one month — November 17, 1914.

At this time I excised a V-shaped piece of the entire thickness of the lower lip, hoping that this would prevent the recurrence of the keloid. The wound healed by first intention. Serial sections showed the same pathological picture as did the tissue of the first operation. Again the induration and discomfort appeared. Figures 4 and 5 illustrate the external appearance of the lower lip and the typical scar on the mucous membrane February, 1915, 3 months after the second and last operation. On the whole, the induration was less than before my first operation, and perhaps the discomfort was less. By this time I had convinced the patient that he did not have a malignant disease, and that ultimately his discomfort would disappear. I saw him at rather frequent intervals. For one year there was little if any change in either the induration or in the discomfort. By June, 1916, 1 year and 8 months after the second operation, there began a definite change for the better. There were periods in which there was little or no sensation of discomfort, and the attacks in which the lip would swell were becoming less frequent. By 1917, almost three years, the patient admitted for the first time that he was apparently well and he ceased his visits to be assured. In February, 1919, this patient writes that in the past year he has observed swelling of the scar and pain on but two occasions. With the exception of these two attacks he has

Fig. 2. Case 1. Pathol. No. 16407-x. A denser portion of the scar tissue as compared with Fig. 1.

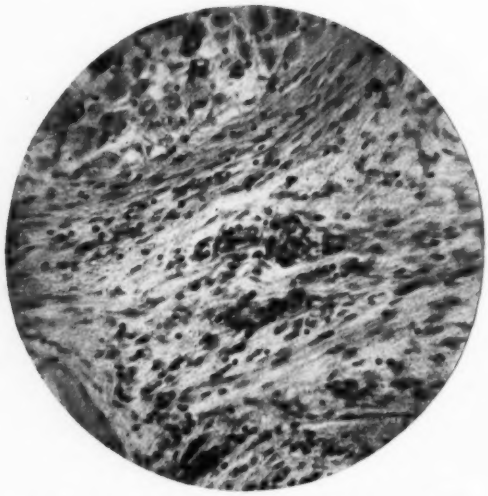


Fig. 3. Case 1. Pathol. No. 16407-x. High-power photomicrograph of area from Figure 2, showing cellular areas, spindle cells, fibroblasts and remains of degenerated acini of mucous glands.

very little unnatural sensation in the scar; the visible external swelling has disappeared. July, 1919, examination: well; induration has disappeared.

This patient was a smoker, and apparently the original lesion was a leucoplakia due to smoking. However, I have no evidence that the resultant scar and its pain had anything to do with the irritation due to the use of tobacco. This patient stopped smoking after my first operation in 1914 and did not resume for three years. The Wassermann blood reaction was negative. The patient was otherwise healthy. His teeth, as shown in the photograph, were in good condition. His local discomfort was real, because there were periods in which he was free from the pains and sensations.

It does not seem helpful to the problems of diagnosis and treatment to take space for the discussion in detail of the character of the sensations in this scar in the mucous membrane of the lower lip.

It was the long and careful observation of this case that has helped me in the recognition and treatment of the patients who subsequently came under my observation.

Case 2. Pathological No. 17280½. Dr. J. McD. Scar-tissue tumor observed in April, 1915. No operation. Well, April, 1919, four years.

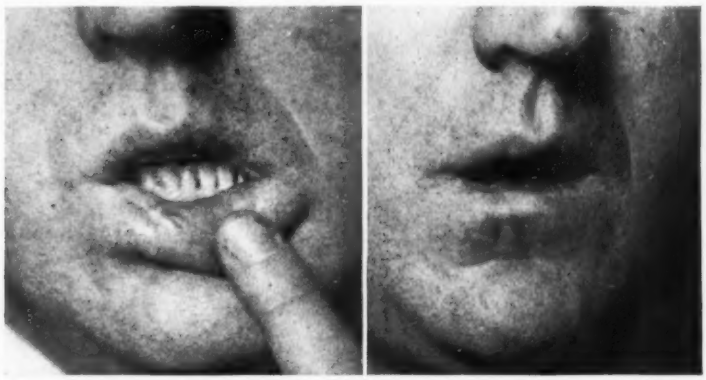
This patient, a white male aged 40, had had a small scab about 8 millimeters in diameter excised from the mucous membrane of the left side of the lip 6 weeks before I saw him in April, 1915. At that time the scab rested on a small red area and was surrounded by an area of slight induration. This little lesion had been observed 3 months before the operation. The patient is a smoker, and the cause of the little ulcer on the mucous membrane of the lower lip may be explained by the projection out of line of the second incisor of the upper jaw.

The pathological report on the microscopic section from the small area removed was as follows: "I find there is a dipping of the epithelial cells into the deeper tissue which is suggestive of malignancy. It would seem advisable to remove some more tissue on one side where it showed that this tumor had been cut rather close."

Two weeks later, 4 weeks ago, on account of this report, the scar was completely excised without cutting any skin. Nevertheless in this short space of time (2 weeks) between the first and second operation a definite induration in the scar had formed. This scar, now 4 weeks since the second operation, closely resembles that pictured in Figure 4 (Case 1).

I telegraphed the laboratory in which the original pathological diagnosis was made and received the report that both the section and the tissue had not been saved. The bit of tissue removed at the second operation was also lost.

Therefore, in this case there was no way of confirming by a re-study of the microscopic section the original diagnosis. Fortunately, I



Figs. 4 and 5. Case 1. Pathol. No. 16407. The appearance of the scar-tissue tumor three months after the second and last operation. The microscopic appearance of the tissue removed at this operation is shown in Figures 1, 2 and 3.

was familiar with a case of similar nature in which the microscopic study (Fig. 6) showed the dipping of the epithelium of the epidermis due to the pressure of a tooth, and this patient has remained well 10 years after the excision of this tissue. In this case, from the report of Dr. L. C. Ingram, of Deland, Florida, who operated, I could pretty certainly conclude that the lesion in the first instance was excised with a good margin, and for this reason the patient was advised against a third operation. In April, 1919, 4 years later, this patient writes: "My lip has remained unchanged and has given me no trouble."

Here we have evidence that the scar tumor may remain for 4 years, but give no discomfort.

CASE 3. Pathological No. 22001. Mrs. D. O'D. Extensive scar-tissue tumor on lower lip first observed in August, 1917. April, 1919, almost 2 years still giving discomfort with attacks of intermittent swelling. July, 1919, examination: well; no induration.

Clinical history. White, female, aged 37. Five months ago when the patient was cleaning her teeth a piece of mucous membrane was abraded and a little ulcer formed. Following the advice of her physician, it was treated twice daily with iodine, and the ulcer increased in size to that of a five-cent piece, and at the ulcer edge a little wart formed. This area was treated by repeated excisions with the scissors, curetting and the application of silver nitrate.

One week before I saw the patient on August 10, 1917, the area had been excised and the wound closed. The following pathological report was sent to me: "Diagnosis: Carcinoma spinocellulare. Sections show hypertrophy of mucous membrane with islands of squamous cells free in the submucous tissue. Beneath one area of ulceration there are nests of atypical squamous cells invading the surrounding connective tissue."

Figure 7 shows the huge scar involving the mucous membrane of the lower lip with hypertrophy of

Fig. 6. Pathol. No. 9458. Photomicrograph of section to illustrate the microscopic appearance in Case 2. White, male, aged 35. Dent or crack in the mucous membrane of the upper lip opposite a projecting second incisor. Slight ulceration in depth. Observed three months. The crevice is 6 millimeters long and the width of a hair. There is slight induration about it. Excised in 1909. Well 1919—ten years. The section shows that the epidermis has been pushed in, and in some places the basal epithelium has disappeared, and the transitional epithelium is projecting into the connective tissue.

Fig. 7. Case 3. Pathol. No. 22001. Extensive scar-tissue tumor on mucous membrane of lower lip following treatment with caustics and excision.

the mucous membrane. The patient was suffering intensely. The lip was extremely tender, and she was almost hysterical with nervousness and apprehension. I tried, but failed to obtain the original section. For this reason 7 days later, August 17, 1917, I excised a V-shaped piece of the lower lip removing most of the scar. Had I removed more I would have produced great mutilation.

The microscopic study of this tissue removed showed hypertrophy of the mucous membrane, cellular granulation tissue and scar tissue, but no evidence of carcinoma. Later I was able to examine the section of the tissue originally removed, but could not confirm the diagnosis of carcinoma spinocellulare. Figures 8 and 9 are photomicrographs of sections from the tissue removed at the first operation, and show the areas of hypertrophied mucous membrane with downgrowth of the epithelial papillary body which were considered malignant by the pathologist.

Figure 10 is a photograph of the lip some months after my second operation. The scar is smaller as compared with Figure 7, but the discomfort remains the same and the patient still has periods in which the lip swells and during this time the pain is worse.

This patient writes in April, 1919, 1 year and 8 months after my operation, that although the condition is no worse, it is not much better. It is to be remembered that in Case 1 the pain and intermittent swelling did not begin to improve until after one year and eight months.

In Case 3 we had a rather difficult problem, because the diagnosis of carcinoma had been made by a well trained pathologist. However, as I have recorded before, cancer of the mucous membrane of the lower lip is a rare lesion and cancer of the mucous membrane of the mouth is very seldom observed in women. Nevertheless cancer does begin in unhealed ulcers following trauma, and for this reason it had to be considered as a possibility in this case. In this individual there was no evidence of syphilis and the Wassermann was negative.

Case 4. J. C. B. No. 8288. Small, painful scar-tumor on mucous membrane of lower lip observed in January, 1918. Well April, 1919, 1 year and 4 months. Mrs. E. S., age 45, was referred to me by Dr. John C. Geiger, Huntington, West Virginia.

In the previous June, 1917, 7 months before Dr. Geiger removed a small submucous nodule from the mucous membrane of the left side of the lower lip. This nodule had been present a few weeks. A definite scar-tissue tumor formed in the wound which had healed *per primam*, and this, because of pain was excised by Dr. Geiger 5 weeks ago. No tissue was saved for pathological examination. In this case the scar was not very large, nor the discomfort very severe. The remissions of pain and swelling were as distinct as in the other cases.

The patient writes April, 1919: "The small lump is still on my lip, but gives me no trouble."

Fig. 8. Case 3. Pathol. No. 22001. Low power photomicrograph of the tissue first removed from the mucous membrane of the lip in Case 3 and incorrectly diagnosed carcinoma on account of the atypical down-growth of the hypertrophied epithelial papillæ. The cellular scar tissue is shown beneath the hypertrophied epidermis.

I concluded from the history that the original tumor was either a cyst or an adenoma of the labial mucous glands, and at that time (January, 1918), I was sufficiently familiar with this lesion to advise against further operation.

The most common tumor on the mucous membrane of the lower lip is a cyst of the labial glands.

CASE 5. Pathological No. 23572. Scar-tissue tumor on lower lip. History of two operations and radium treatment. Observed in August, 1918. April, 1919, much improved.

Clinical note. Mr. B. C. Y. was referred to me by Dr. Edwin L. Ellis, Maryville, Tennessee. The age of the patient was 37. There was first observed a submucous nodule the size of a pea on the mucous membrane of the lower lip. This was about 2 years ago. After it had been present 3 months it was removed with some kind of caustic. Within 4 months after this operation an indurated area formed in the scar which became painful. This area was excised by another surgeon 1 month before I saw the patient; then the patient received radium treatment.

I had the opportunity to examine the sections from the second operation. It resembled microscopically the cases already described and illustrated in this article. The Wassermann was negative and the blood count normal.

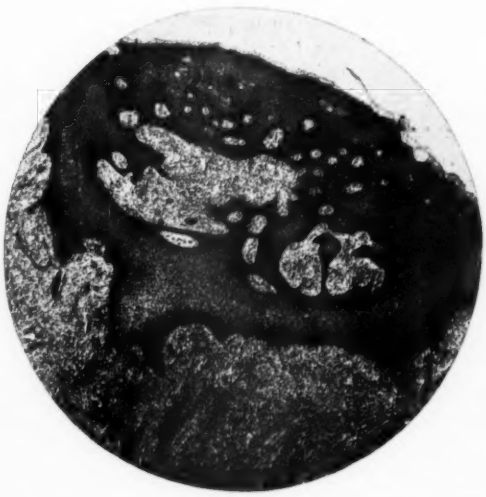


Fig. 9. Case 3. Pathol. No. 22001. Another view of a section from the same tissue shown in Figure 8. This peculiar formation of the thickened mucous membrane is apparently due to cutting the section horizontally and not vertically through the hypertrophied mucous membrane. This section was also incorrectly diagnosed carcinoma.

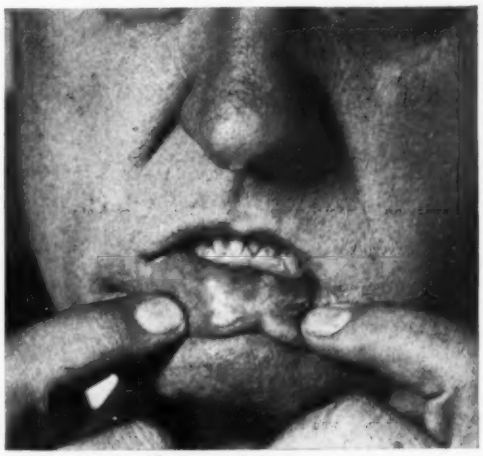


Fig. 10. Case 3. Pathol. No. 22001. The appearance of the recurrent scar-tissue tumor some months after the complete excision of a V-shaped piece of the lip with lesion shown in Figure 7. The operation has improved the local condition.

It is my impression that the original tumor in this case was a cyst or an adenoma of the labial mucous glands. Any operation was advised against.

CASE 6. Pathological No. 23866. Scar-tissue tumor of mucous membrane of the lower lip following the excision of a benign cyst. Recurrence after the excision of the scar. Third operation advised by an experienced surgeon. Observed in February, 1919. Still under observation April, 1919. August, 1919, examination: better.

Clinical note. Mr. H. C. D. was first operated on in October, 1918. Previous to this operation I elicited the following history. White, male, age 48, smoker; in August, 1918, 3 months before operation, and 4 months before my examination, the patient observed on the mucous membrane of the left side of the lower lip a small subcutaneous nodule which on one occasion ruptured and discharged mucus. The tumor, however, did not disappear. The lesion received treatment with nitrate of silver. This caustic produced an area of superficial ulceration, so, in addition to the primary nodule, there was a little ulcer with a scab and an area of induration. The patient consulted a number of surgeons and dermatologists.

The tissue excised was examined by Dr. J. Homer Wright, of Boston, whose report is as follows: "There is some hyperplasia of the epithelium and at one point there is a cleft in the mucosa which seems to communicate with what appears to be a dilated lymph-channel, or which might be in connection with the salivary gland duct near it. Such a duct

Fig. 11. Case 6. Pathol. No. 23866. Photomicrograph, low power, showing the hypertrophied and changed mucous membrane and the cellular and vascular scar tissue beneath the epidermis.

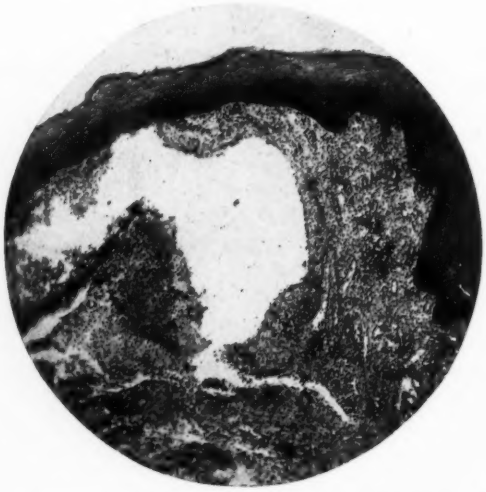


Fig. 12. Case 6. Pathol. No. 23866. Photomicrograph, low power, of what appears to be a lymph cyst in the cellular and vascular granulation tissue beneath an area of thin epidermis.

and salivary gland tissue are present in the section. There is no evidence of malignant disease."

I am inclined to think Dr. Wright means when he writes "salivary glands" one of the mucous glands of the lip, and what he describes I have seen in similar cases in which I have removed the primary cyst of one of these labial glands.

After the operation, the wound healed partly by granulation, and an indurated area formed in the scar.

Second operation, December 12, 1918. This operation was performed by another surgeon in another city. The scar of the mucous membrane and submucous tissue was excised and the wound closed. Although the wound healed by first intention, the induration in the scar returned immediately. The surgeon who performed the second operation advised a third, in spite of the fact that the microscopic section of the tissue removed showed no evidence of malignancy.

It was at this time (February 2, 1919) that I first saw the patient. The scar resembled that illustrated in Figure 4, Case 1. The patient's description of his discomfort in the lower lip and the periodical attacks in which the lip would swell, was identical with those in Cases 1 and 3. I had the opportunity to examine the sections. Figure 11 shows the hypertrophy of the mucous membrane covering the scar and the cellular scar tissue beneath. Figure 12 shows an area of the scar covered with thin epidermis beneath which there is a cavity apparently lined by endothelium suggesting a lymp-cyst, and this is surrounded by very cellular vascular granulation tissue, in which in places we can recognize remains of gland tissue. Figure 13 shows the change in the lobule of the mucous gland surrounded and invaded by the granulation tissue.

The intermittent swelling of the lip in these cases may be explained by retention of secretion in the mucous gland or by the formation of lymph-cysts. In all of the sections which I have examined, I found both lymph-cysts and remains of mucous-gland tissue in the granulation scar-tissue.

In this case (Case 6) in view of my recorded previous experience I felt justified in advising against further operation. We had an examination of the tissue first removed, by a well-trained pathologist which practically excludes malignant disease and also an opportunity to re-investigate the sections of the tissue removed at the second operation. There, therefore, was no indication for re-operation on the diagnosis of possible malignancy, and this experience again demonstrates that operation is not helpful in a scar-tissue tumor occurring on the mucous membrane of the lower lip.

CONCLUSIONS

I have reported these six cases of scar-tissue tumors occurring on the mucous membrane of the lower lip because my records show that the majority of surgeons are apparently not familiar with the rather frequent occurrence of a painful induration in the scar after the excision of a lesion on the mucous membrane of the lower lip, and even in some cases experienced pathologists have diagnosed sections as suspicious of malignancy, or even in one case (Case 3) of carcinoma.

However, it was the experience with the last case (Case 6) which urged an immediate report. This patient had seen at least a dozen surgeons and dermatologists in four large cities, and not one of them expressed the opinion that it was a simple scar-tissue tumor; none of them seemed to be familiar with the possible benign and malignant lesions of the mucous membrane of the lower lip.

Studying the records of the pathological examination Dr. Homer Wright of Boston seems to be the only one who has made a clear microscopic description and a positive conclusion that there was no evidence of malignant disease. The surgeon who operated on the patient in Case 6 for the scar-tissue tumor advised, I am informed, a third and more extensive operation based on the view that it might be malignant, in spite of the fact that the pathological examination of the tissues excised both at the first operation and at the second, showed no evidence of malignancy.

These scar-tissue tumors on the mucous membrane of the lower lip have apparently no relation to the nature of the primary lesion, whether it be in the mucous membrane or in the submucous tissue. Apparently they are more apt to occur in the first instance when the primary lesion had been treated with caustics, or when the wound has healed by granulation.

When I compare these six cases of scar-tissue tumors of the mucous membrane of the lower lip with the resultant scar in small groups of cases in which I have had the opportunity to excise the primary lesion of the mucous membrane of the lower lip, I find that in all of my own cases, in spite of the fact that no cautery had been employed and that the area was excised with a sharp knife and that with few exceptions the wound healed by primary intention, slight indurations have always formed in the wound, and some have been painful, resembling, therefore, closely Case 4, but in none of these cases has a scar-tissue tumor been of the extent or as painful as in Cases 1, 3 and 6 reported here.

Fig. 13. Case 6. Pathol. No. 23866. An area in the scar-tissue tumor showing mucous glands surrounded and infiltrated by granulation tissue.

These cases reported in detail with this discussion seem to present the problem clearly and to settle the method of treatment — non-interference.

It also emphasizes the fact which I have mentioned before of the importance of subjecting, even the most innocent lesion to a microscopic examination and to keep the sections and some of the tissue for future study.

At a later date I shall discuss lesions of the mucous membrane of the upper and lower lip, as well as scar-tissue and granulation tissue tumors on other portions of the lips.

SOME POINTS IN WAR SURGERY[1]

By JAMES RUTHERFORD MORISON, M.D., F.R.C.S., Newcastle-upon-Tyne, England
Surgeon, Northumberland War Hospital

THE first point I should like to discuss is concerned with the reputation and mentality of the medical profession, as the War has drawn special attention to it. All of you know how much doctors have done, and how generously the value of our services has been talked about—but there is still a good deal wrong in our relations to the public, and my view is that we should look facts in the face and ask ourselves the straight question—Why is it so?

Suppose one of us made a visit to the smoke room of the House of Commons, or any other popular business club, and heard a request by one of the members to be advised by those present as to the best man to consult because of a damaged knee, what do you think would be the verdict? Go to Sir Robert Jones? No, not at all. It would be almost unanimously, "Consult Barker, the bonesetter." On inquiring why, we would be informed, first, that he is a genius with joints; and, second, that he cures cases which the doctors have failed to relieve, not by ones or by twos, but by hundreds. Do you believe it or do you not? If not, you are not looking facts in the face. Barker *is* a genius, and he *has* cured hundreds of cases which doctors have failed to relieve.

Is there any wonder that the refusal of his offer to treat wounded soldiers and the refusal of the military surgeons to appoint a commission to inquire as to his methods and results, which he offered to explain and demonstrate, should have caused bitter public feeling against the doctor? The man in the street calls it professional jealousy, and the result has been such an advertisement for Barker as has made him so well known that he is now probably rich beyond the dreams of avarice.

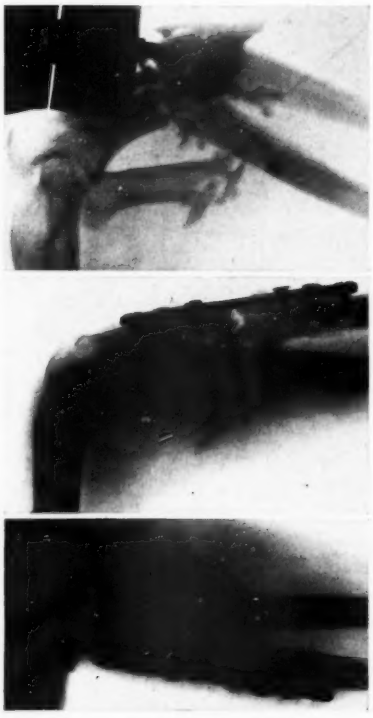
What do you think would have been the result from a surgical commission of inquiry? To a certainty it would have been that Mr. Barker's reputation was based upon his miraculous cures—upon the cases that came limping to see him with a crutch or stick, and, after "a manipulative operation" under an anæsthetic, walked away from his consulting rooms sound men or women.

Sir Robert Jones knows these cases. He looks carefully for pathology, and, finding none, says: "There is nothing the matter with your joint. Give up that crutch and stick. Use the joint, it will soon be all right." This is not popular advice and the patient probably goes home with a sore, undignified, fraudulent sensation, and does not advertise the experience. But Barker sees no pathology, only a disabled, painful joint which he must cure by an "operation under an anæsthetic," and sends his patient home delighted and full of praise.

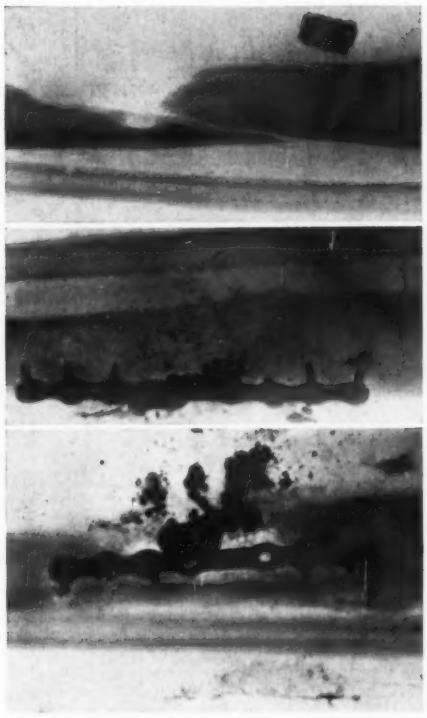
Here I should like to tell you how I think Dr. Crile, the celebrated American surgeon, would explain the miraculous cure of these lame and painful joints. He would say something like this: "Pain to the individual is the most important thing in all the world, because it acts as a stimulant to the chief of the primitive instincts—the protective. To our earliest ancestors a ruptured semilunar cartilage could be nothing short of a calamity. The pain and disability attending it would be accompanied by the fear of death from surrounding enemies as no escape by flight would be possible. The effect of strong stimuli on such an instinct is difficult to eradicate, and in susceptible subjects is apt to leave a long-standing mark, which requires an extraordinary counter-irritant to remove it. A chase by a bull, Christian Science, the possibility of being drowned, operation by an imposing specialist, any of these, may cure these lame and painful joints, with no organic change in them now, but retaining still a memory of pain and disability and old injury."

This subject is of such enormous importance that I cannot leave it at that.

[1] An address delivered on February 4, 1919, before the Northern Command Medical Society.



Figs. 1, 2, and 3. Fracture of the right forearm. Private F., wounded July 31, 1917. "Bipped" in France. Admitted to the Northumberland War Hospital, August 26, 1917. Examination showed bowing, shortening and marked deformity of the right forearm, with large deep wound packed with "bipped" gauze. On removing this, the lower end of the ulna protruded from the wound. Operation, August 31, 1917, at which time the forearm was wrenched into position and the ulna plated. On October 13, 1917, the wound was dressed for the first time. Except for some caked blood the dressing was almost dry. The wound had closed except a small area at the center. On October 18, 1917, the splint was removed. January 26, 1918, a probe inserted into the sinus led down to the bare plate which was removed. The patient was discharged March 30, 1918, with wound healed and the shape and all movements except supination were good.



Figs. 4, 5, and 6. Fracture of the tibia. Private H. was wounded November 4, 1918, by a shell. He was admitted to the Northumberland War Hospital, November 15, 1918. He had a large elliptical wound measuring 3½x1½ inches, with the bare fractured tibia exposed. There was another similar wound on the posterior surface, from which pus poured when dressing was removed. Operation November 19, 1918. The wound was explored, and the fragments of bone and the foreign body seen in the plate were removed. The wound was "bipped" and a Lane plate applied. The patient is still in the hospital. The bone is firmly united and in good position. There is still a superficial granulating wound.

We have recently had a visit here from Colonel Hurst, and he lectured popularly and professionally on psychotherapy as applied to war injuries and diseases. Briefly his conclusions amounted to this: That all cases of shell shock of more than a few weeks' duration; the majority of cases of paralysis; cases of deafness; loss of voice; frequent symptomless vomiting; contracted painful stiffened limbs and joints, without gross lesions sufficient to account satisfactorily for them, were hysterical. Not only that, but many conditions producing signs of organic disease were complicated by hysteria, and, if the hysterical part could be exorcised, the patient, utterly helpless before, might once more become efficient for the ordinary duties of life. He exhibited photographs of cases, treated by his colleagues and himself, before and after the cure; hopeless looking arms and legs cured in half an hour, after unavailing treatment in other hospitals for months; paralytics of months' duration,

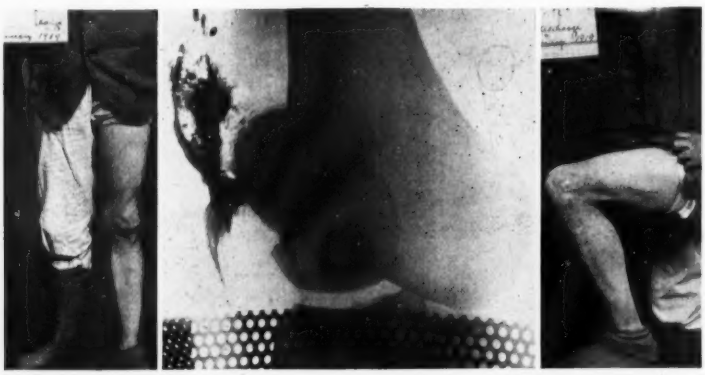
Figs. 7 and 8. Gunshot wound of the right leg, with fracture. Private T. was wounded October 22, 1918. Note from Casualty Clearing Station: "Very bad fracture, much overlapping. Wound foul." On admission to the Northumberland War Hospital, October 31, 1918, there was found a large septic wound 6x5 inches, on the inner and anterior surfaces of the right leg. Examination made November 6, 1918, showed the upper fragment of the tibia driven into the calf muscles and firmly embedded. It was "bipped" and plated. Later the patient had a high temperature and trouble in the knee-joint. He is still in the hospital and is doing well.

pronounced elsewhere incurable, walking in a few days . . . To cut a long story short, he and his colleagues made the lame to walk, the blind to see, the deaf to hear, and almost raised the sick and the dead, and no one, who heard the lecture and saw the pictures, could, if the facts were faced, doubt the truth or importance of them.

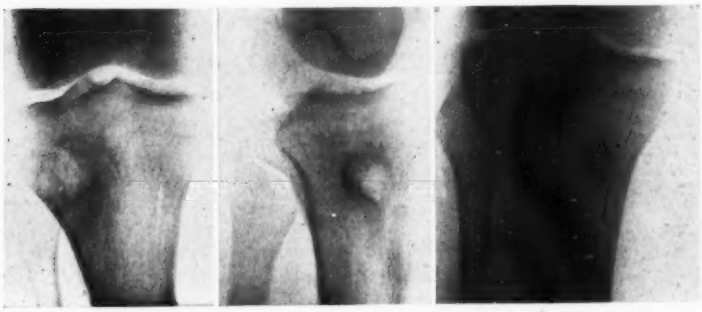
What are the physicians going to do about this? The possibility of cure of such formidable conditions without an operation, massage, electricity, ionization, whirlpool baths, radiant heat or heliotherapy, ought to determine some activity. I hope that it may expend itself here on the establishment of a special neurological department of the infirmary.

Colonel Hurst described his method in some detail, and called it psychotherapy. That, of course, is the guinea name. In ordinary language, the patient is told, "You are no longer ill," and is induced to take up his bed and walk. As in Mr. Barker's cures, the miraculous rapidity of Colonel Hurst's results is the striking feature, and I want to emphasize this point.

When salversan was introduced for the treatment of syphilis, two of my colleagues



Figs. 9, 10, and 11. Penetrating wound fracture and (one of many "bipped" in France with excellent results) of knee-joint. The patient was wounded August 7, 1917, by shrapnel. Note from the Casualty Clearing Station: "Penetrating gunshot wound of the knee-joint. The foreign body entered anteriorly, grooving the outer border of the patella and entering the external condyle of the femur, in which it lodged." The wound was opened up in France and "bipped." On admission to the Northumberland War Hospital, on August 26, 1917; "bipped" pack in wound extending through knee-joint in external condyle of femur. Photographs taken on discharge, January, 1919.



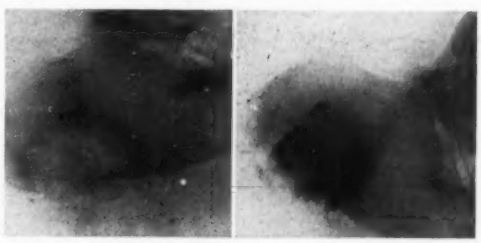
Figs. 12, 13, and 14. Roentgenograms showing replacement of fat by bone. Corporal G., wounded April 6, 1917, by shell, suffered a septic wound with skin gap of 2 inches, leading into the head of the tibia. Operation, June 19, 1917. Deep bone cavity involving almost full depth of bone was "bipped" and filled by fat grafts from thigh. The cavity was covered over by thick skin flaps transplanted from inner side. August 20, 1917, healed.

went to London to judge of results for themselves, and came back with an enthusiastic report. They told me that a single dose killed all the spirochætæ and that in a few days the patient was cured. My reply was that I did not believe it, that syphilis was a *real* disease, and that Nature's methods were always slow.

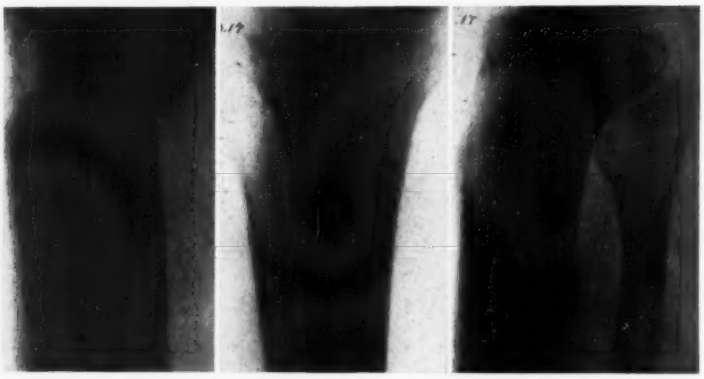
The public, who are still always on the outlook for a miracle, should be taught that a *real* disease cannot be so suddenly cured; an *unreal* one may. It scarcely helps to call the one organic, the other functional, hysterical, or neurotic. The essential thing to understand is that patients may be divided into three classes: (1) those with real diseases; (2) those with real diseases and some unreal features superadded; and (3) those with unreal disorders. From Colonel Hurst's experiences, it should be clear to everyone that the third class is of the greatest importance. Allowing for an excess of enthusiasm and a lack of the after history of many of his cases, any just judge must admit that his cures are something extraordinary; more extraordinary than the advances made in the treatment of syphilis. The only comment I have heard about these lectures was made at the popular one. A gentleman, I understand, got up in the audience and said: "This is a put up job to rob our disabled soldiers of their pensions." So it seems possible that the doctors may escape painful criticism.

It should be recognized that the dangers of this form of treatment are not small, because the result depends upon diagnosis, and this, in the best hands, is still too often uncertain. It is such a tragedy to treat a cerebral tumor, or an organic paraplegia or a pathological joint as unreal, that everyone of us would rather err on the safe side, and go on "making mistakes," and this is the present difficulty. If no suggestion could be offered to diminish this risk, I would not have mentioned it, but this is my solution—military service has gone a long way to introduce it, and if the war lessons have been properly learned it should be easy to carry it through.

All cases, then, in which there is reasonable doubt as to diagnosis, should be advised of



Figs. 15 and 16. Cavity in the os calcis. Driver Y., wounded October 14, 1918, admitted to Northumberland War Hospital, October 24, 1918. January 8, 1919, cavity in os calcis cleaned, "bipped," and filled with three fat grafts. Flap sutured over. On January 25, 1919, the wound was dressed for the first time, and was found healed except where one septic sinus had been excised.



Figs. 17, 18, and 19. Cavity in head of the tibia. Gunner P., wounded August 12, 1917, admitted to Northumberland War Hospital, August 26, 1917, with sinus into the head of the tibia. Operation, October 3, 1917. The cavity was cleaned, "bipped," and filled with fat and covered with skin flap.

the difficulty, and sent to hospital for team supervision and diagnosis. A physician, surgeon, pathologist, specialists, X-ray operator, bacteriologist and biochemists should be asked by the patient's doctor to help in solving the problem, and, if necessary, a period of observation allowed before such drastic treatments as operation or pyschotherapy are recommended. This evolution ought to start with our profession, who realize the need of it, and the public would soon be impressed with its value and importance to themselves. Selfishness and professional jealousies have prevented its previous adoption. We have

Fig. 20.

Figs. 20, 21, and 22. Comminuted fracture of the tibia, fibula cracked. Private M., wounded April 9, 1917, by a shell. He gave a history of 13 operations on his leg. After failure of these he was told that it was incurable. On admission to the Northumberland War Hospital, June 29, 1918, there was found much thickening of both bones of the leg, with suppurating sinuses. The X-ray showed sequestra in cavities in the tibia. Operation July 3, 1918, at which time the cavities were opened, cleaned, "bipped," and filled with fat from the thigh. The wound was covered with skin flap. The patient was retained in the hospital for some weeks after healing had occurred to see whether the result was likely to be permanent. He was discharged January 4, 1919, quite healed.

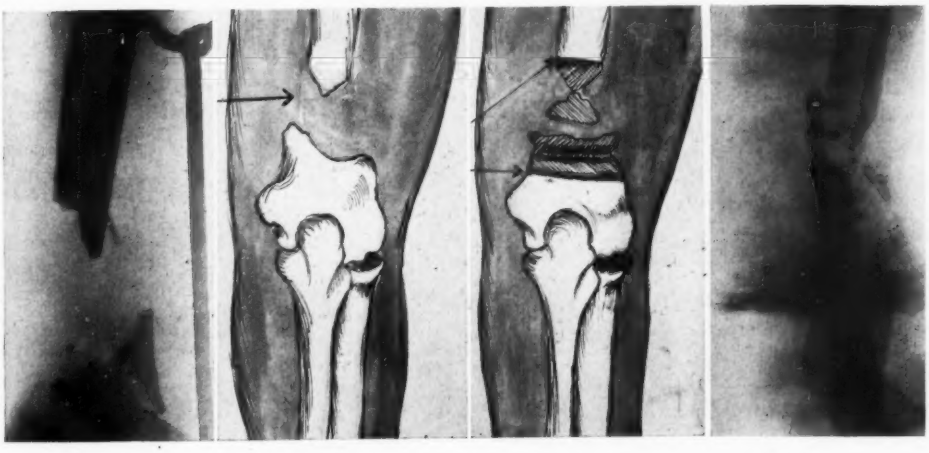


Fig. 23. Fig. 24. Fig. 25. Fig. 26.

Figs. 23 to 28. Septic compound fracture of upper arm. Gunner S. was admitted to the Northumberland War Hospital, September 1, 1918. The roentgenogram shows the gap in the bone, October 5, 1918. Fig. 24 is a diagrammatic drawing of the roentgenogram, the arrow pointing to the defect in the bone. Fig. 25 shows the preparation of the humerus for bone graft. A transverse saw cut was made nearly through the bone and the bone ends, still attached by soft parts, then turned down into the gap. The arrows point to saw grooves.

Figs. 26, 27, and 28. Roentgenograms and diagrammatic drawings showing transplantation of graft from tibia into defect in humerus. Note that one screw at each end is holding the graft and two the shaft. The plate is too short. It should have been double the length above the graft. Fig. 28. Diagrammatic drawing of roentgenogram. The result was abundant callus with firm straight union. The metal plate has not been removed.

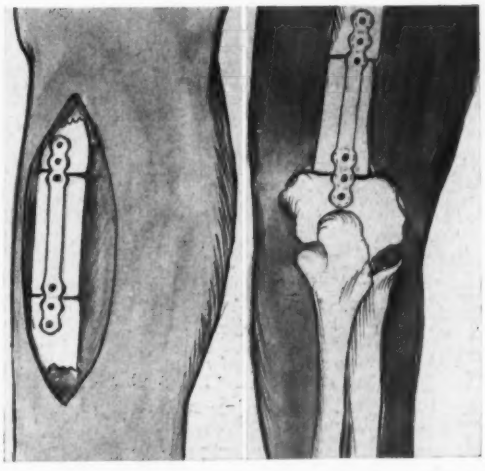


Fig. 27. Fig. 28.

no business to worry anyone about the future of the medical profession until these have been scotched, or if that is impossible, repressed.

WOUND TREATMENT

Surgeons have always been, and are still, too modest. In my early surgical days the physicians, later the pathologists, and at present the bacteriologists, have dominated all our views.

Team-work is now essential to progress, but I hold that clinical experience and observation should still occupy the first place in surgical work, and that it will be bad for surgery when they do not do so.

It is 41 years since my first paper on wound treatment was published in the transactions of the South Durham and Cleveland Medical Society, and at that time my views were regarded as revolutionary, and no one faced the reported facts. Lister had proved, by his magnificent work, that operation wounds might confidently be expected to heal without suppuration or constitutional disturbance. The rule then was free tube drainage and frequent dressings—the same principles as were taught in the early stages of the war for its infected wounds. My contention was that,

Fig. 29 (above). Fig. 30 (below). Fig. 31. Fig. 32.

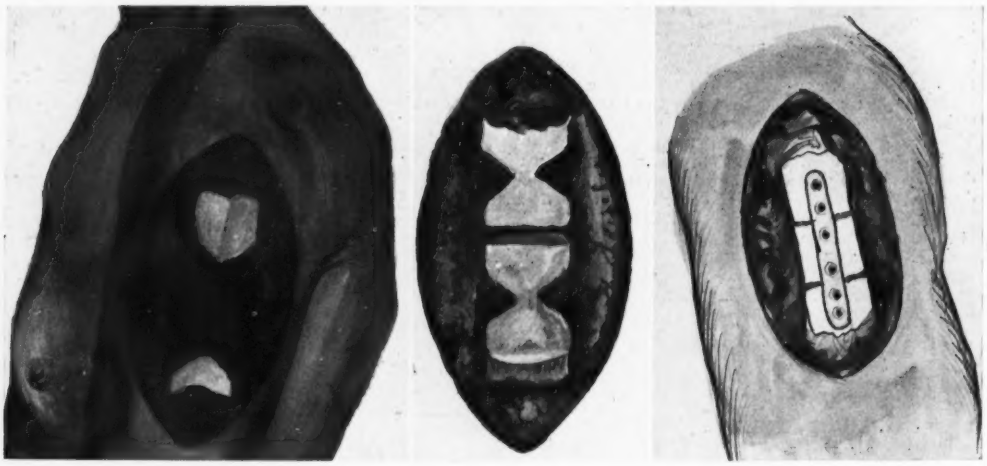
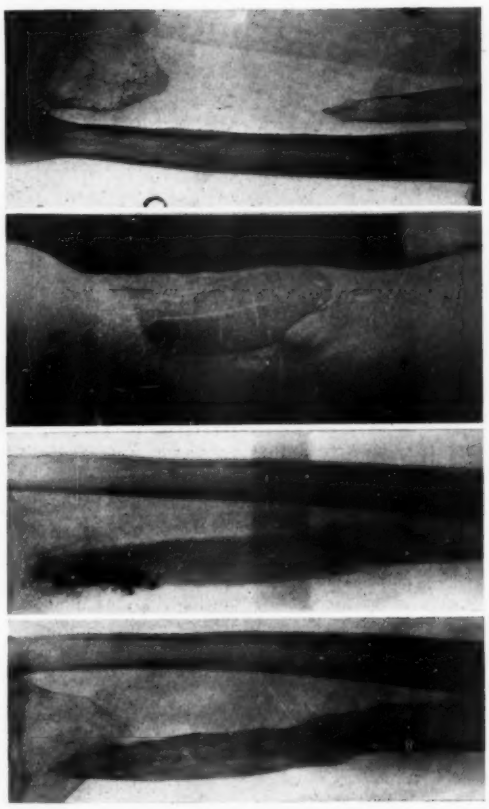


Fig. 33. Fig. 34. Fig. 35.

Figs. 29 to 35. Large gaping foul wound of upper arm. Corporal B. was wounded April 30, 1917, and admitted to the Northumberland War Hospital, May 19, 1917, with large gaping foul wound of upper arm, 9 by 4 inches, discharging pus freely. Two inches of humerus were gone and musculospiral paralysis was present. On January 2, 1918, the wound was healed but there was no union of the humerus and complete musculospiral paralysis was present (Fig. 29). On January 6, 1918, the fracture was exposed (Fig. 33). The fractured ends were sewed nearly through and turned down into the gap, still adherent to the surrounding soft parts (Fig. 34). The graft of tibia was fixed by plate and screws in bone gap (Fig. 35). The wound healed under a single dressing, which was removed February 27, 1918. May 24, 1918, 4½ months after grafting, while convalescent the patient fell into a ditch and broke his arm. On June 8, he returned to the hospital. X-ray examination showed the "graft in position and surrounded by callus. The fragments were at a slight angle with convexity forward. Two upper screws of plate were lying loose out of the holes, one of the lower screws was partly loose." The fracture had united with very small deformity. Note the graft and screw holes (Fig. 30). June 29, result of transplantation of flexor carpi radialis into wrist extensors. Plate was removed at the same time (Fig. 32, October, 1918). Final result a badly scarred, but good looking and useful arm.



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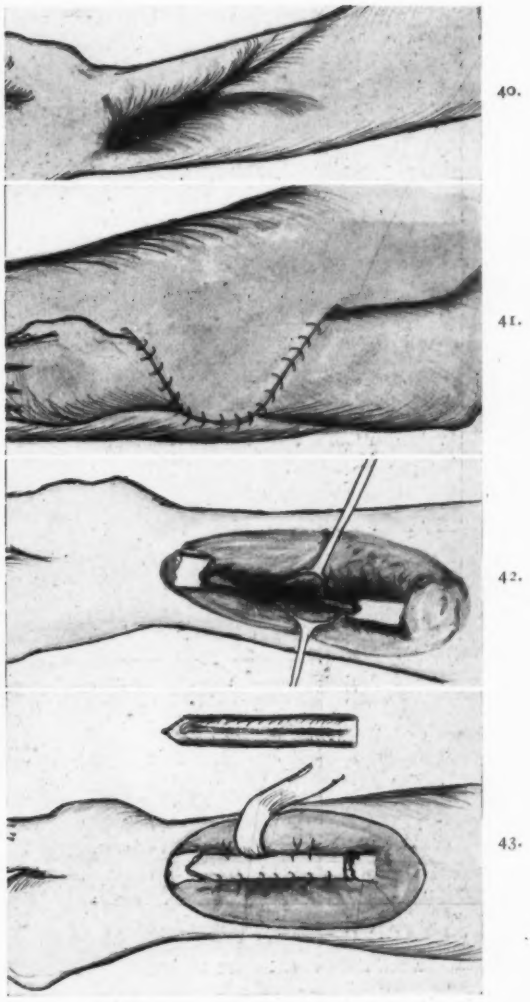

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Figs. 36 to 43. Extensive sloughing wound of the left forearm. Private B., wounded May 13, 1917, admitted to Northumberland War Hospital, May 19, 1917, with extensive sloughing wound of left forearm. The tendons and muscles were exposed. The radius was shattered above, the middle portion of the bone missing.

Fig. 36. Roentgenogram taken February 11, 1918.

Fig. 37. March 6, 1918. Flap separated, healed. Note crisscross scarring of flap.

Fig. 38. August 2, 1918. Dressing and splints left undisturbed for six weeks. Then the wound was found entirely healed, all sutures absorbed, good union of graft.

Fig. 39. October 16, 1918, four months after grafting. The arm is strong, the hand in good position and function fair; rapidly improving.

Fig. 40. First operation, February 13, 1918. Whole of radiating scar excised from forearm.

Fig. 41. Flap turned off thigh and sutured over bare area of forearm.

Fig. 42. Second operation. June 12, 1918. Hand wrenched into good position. Broken ends of bone exposed in dense scar tissue throughout.

Fig. 43. Bone ends prepared for reception of graft. Upper end laid on shelf of upper fragment and tied with catgut. Lower wedge-shaped end of graft forced into lower fragment. Periosteum of graft sutured with catgut to surrounding scar tissue. Skin wound closed throughout with catgut. At lower end of wound there was tension, so covered with "bipp."

if Lister's teaching was true, open wounds made by the surgeon should heal as subcutaneous ones did, without drainage, without constitutional disturbance, without the need of removal of sutures, if catgut was employed, and under a single dressing. The cases reported in that paper, and later many others, because I renewed my attack from time to

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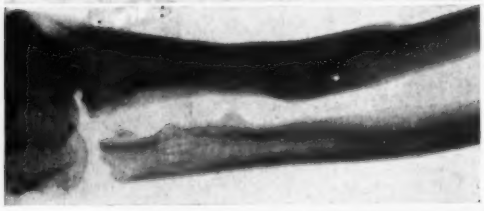

Fig. 50. Empyema case. Penetrating gunshot wound of the chest. Hæmopneumothorax. The patient was wounded November 5, 1918, and was admitted to the Northumberland War Hospital, December 4, 1918, with temperature of 102°. On December 11, 1918, a tube was inserted into the wound and one and a half pints of thick pus evacuated. January 8, 1919, operation by Professor Morison. Chest was freely opened by wide resection of rib. The foreign body was removed, the cavity "bipped," two "bipped" gauzes were put in and the wound sutured with "bipped" silk, except where gauzes protruded. These were removed on January 18. February 3, 1918, healed, no pus was seen on the dressings above the operation.

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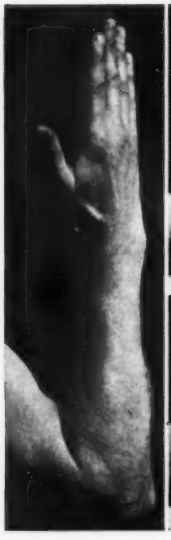

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Figs. 44 to 49. Fracture of right forearm. Gunner L., wounded March 21, 1918, by base of shell. Admitted to Northumberland War Hospital, July 19, 1918. Flexion was possible to not quite a right angle, extension very limited, pronation and supination impossible. July 31, 1918, bone uniting radius and ulna chiseled away, dislocated head of the radius excised, and a portion of the fascia lata, about 2½ inches square, taken from the right thigh was placed between radius and ulna, fascial side next to fracture of ulna. The muscles were sutured over with catgut, and skin with catgut. The arm was put up in full supination. On August 14, 1918, first dressing, wound was found entirely healed. Result: an excellent arm.

time as opportunity offered, were the strongest possible evidence in proof of what I said, but no notice, so far as I know, was taken of them. Surgical information moves along more rapidly now, but still not quite so quickly as it should. It was at least twelve years later before I saw the after-treatment of wounds develop at all in the direction I had indicated, and even now non-absorbable sutures and drainage are the rule.

No such ideal method of treatment for infected war wounds has yet been discovered, but, unlikely as it would seem, experience suggests that the problem may eventually be solved. I have told so often since 1916 how it is possible to close infected wounds, and even acute abscesses, by suture, always with impunity, and frequently to obtain healing by primary union, that it would be waste of time to go over the details again. (They can be found in a small book on the *Bipp Treatment of War Wounds*,[1] published by the Oxford Press.) The only addition I have made to the steps of the method described there is a valuable one. After closing the wound with sutures, smearing it with "bipp" and cleaning the skin surrounding it with spirit, I sprinkle sterile, finely powdered boracic acid freely all around the "bipped" wound, and on the first layers of the dressing. This has diminished infection from the skin, and lessened the dirty discharge which was found in granulating wounds that had been left undressed for two or three weeks. From the first I have specially drawn attention to the importance of this treatment in fracture cases. (See Figs. 1 to 8.) At the present time there are 26 gunshot fractures of the long bones under my care in the Northumberland War Hospital. The average number of days those were left after operation without change of dressing was 13, and it would have been more if some of them had not been taken down for purposes of demonstration. More will be said as to the cases in which "bipp" has been found useful—it is of course as applicable in civil as in military surgery—when the pictures are demonstrated (Figs. 9–10, and 50), but, before dismissing this subject for the present, I would like to read an extract from an article by Colonel Gask, which was published in the January number of SURGERY, GYNECOLOGY AND OBSTETRICS. He says:

"The most dangerous organism to the patient and the one that defeats our efforts up to the present is the hæmolytic streptococcus. Primary suture failed in practically every case, "infected with this organism."

In July, 1918, by invitation of the Director General, A.M.S., I visited the Base Hospitals at Boulogne to demonstrate the "bipp" method of wound treatment. Three of the wounds on which I operated were in No. 14 General Hospital, and I am indebted to the staff for reports of the cases and their after progress. The following are brief but exact extracts from the medical case sheets:

CASE 1. Pte P. on admission to No. 14 General, July 7, 1918. (1) Amputation stump left thigh just above knee, long anterior flap sewn back. Fairly clean. (2) Open buttock wound—septic. July 14, 1918, temperature 102.4°, pulse 108. Stump, bloody serous discharge, wound of buttock very puffy, swelling down thigh on outer side, no localized collection; seemed to be a general tissue invasion. July 15, 1918, streptococcus hæmolyticus isolated from both wounds in fine culture. July 16, 1918, both wounds "bipped" and sutured by Professor Rutherford Morison. July 17, 1918, temperature 103.2°, pulse 112, but felt more comfortable. July 20, 1918, temperature 99.4°, pulse 92, much better, no further puffiness. From this point on temperature never rose above 99°. Pulse varied from 102 to 76, gradually quieting. August 9, 1918. (that is, three weeks after operation, when dressed for the first time according to my instruction (R. M.), the sutures were removed. The buttock wound was soundly healed. The amputation wound

[1] *Summary of technique:* 1. Under an anæsthetic, usually open ether, cover the wound with gauze wrung out of 1:20 carbolic acid, and clean the skin and the surrounding area with the same lotion.

2. Open the wound freely and, if possible, sufficiently to permit of inspection of its cavity. A guide—a finger is the best if the size of the wound permits of it, and if not a thick probe—should be introduced to the bottom of the wound and held there and fully exposed. In doing this special regard must be paid to nerve-trunks and muscular branches of nerves, since the division of blood-vessels, excepting the largest, and of muscles themselves does little harm as compared with that of the disability following nerve damage. Cleanse the cavity with dry sterile gauze mops, Volkmann's spoon, etc., and remove all foreign bodies.

3. Mop the surrounding skin and the wound cavity with methylated spirit and dry it. Put "bipp" in the wound. Preparation of the paste: Iodoform, very finely powdered, 16 ounces; bismuth subnitrate 8 ounces; liquid paraffin, 8 fluid ounces, or a sufficient quantity. The powders are mixed together in a clean mortar, and the liquid paraffin incorporated. The quantity of liquid paraffin varies according to the bulk of the powders, the bismuth in particular being liable to a considerable variation in bulk. A sufficient quantity should be added to make a thick paste. It is then advisable to rub down the paste in small quantities at a time, on a slab with a spatula, to ensure freedom from grit and other particles of powder. This paste is not specially sterilized. (The name "bipp" suggests not only the ingredients, but the relative quantities of bismuth and iodoform.) Rub it in well with dry gauze, then remove all excess, leaving only a thin covering over the wound surface.

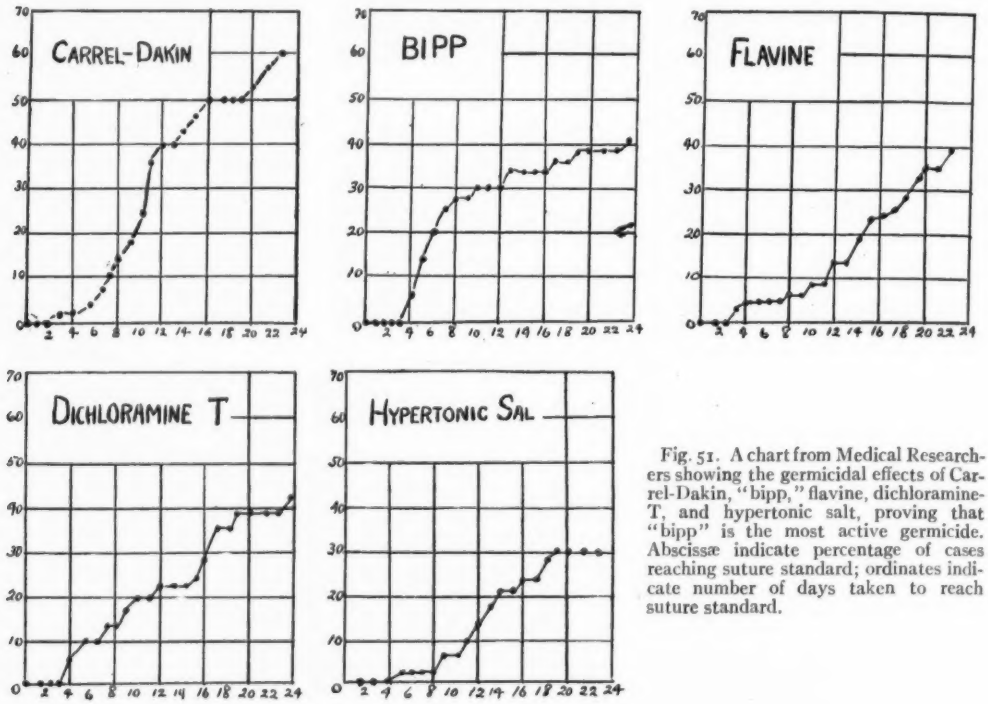

Fig. 51. A chart from Medical Researchers showing the germicidal effects of Carrel-Dakin, "bipp," flavine, dichloramine-T, and hypertonic salt, proving that "bipp" is the most active germicide. Abscissæ indicate percentage of cases reaching suture standard; ordinates indicate number of days taken to reach suture standard.

was not healed; flaps slightly retracted, but quite clean and granulating. Discharged from hospital in good condition. Heard from August 16, 1918 (one week later): "O.K., being measured for temporary limb."

CASE 2. Lieut. Col. B. With amputation below knee, long external flap sewn up without drainage on July 8, 1918. July 11, 1918, at No. 14 General, skin of stump discolored, sutures removed. A collection of blood and pus was evacuated. Temperature 101°. Pulse 100. July 15, 1918, bacteriological examination showed fine culture hæmolytic streptococcus. July 16, 1918, stump "bipped" and sutured by Professor Rutherford Morison. July 17, 1918, fairly comfortable. Temperature 100°. Pulse 120. July 18, 1918, much better. Temperature 98.8°. Pulse 84. After this things ran smoothly as far as temperature and pulse went but he had a good deal of uneasiness in stump and referred pain in the foot. August 9, 1918 (three weeks after operation), sutures removed. The flap had healed but there was a sinus over the middle of the flap where the skin had broken down. At the time of the operation the skin was rather red and was perforated at this point. (Small gunshot wound, button hole suture at primary operation.)

If such large dirty looking wounds as these were, in patients obviously ill, can be closed with success it looks as if Colonel Gask may have to alter his conclusions.

The danger of "bipp" poisoning has been mentioned very frequently, and, in all my papers, I have alluded to the possibility of it. There is overwhelming evidence that it can occur, but I need say nothing more about it now. The mortality figures of operations performed in the Northumberland War Hospital, supplied by Major D'Oyly Grange, prove beyond any question that it cannot be a serious danger, because all of my colleagues there use the "bipp" method.

The total number of operations performed to date was 5500. Of these 27 died, a mortality of not quite 0.5 per cent. Only 10 amputations were performed. No death was attributable to "bipp"—indeed I entertain no doubt that many lives and limbs have been saved by its use (Fig. 51).

SECONDARY HÆMORRHAGES.

Secondary hæmorrhages have added to the

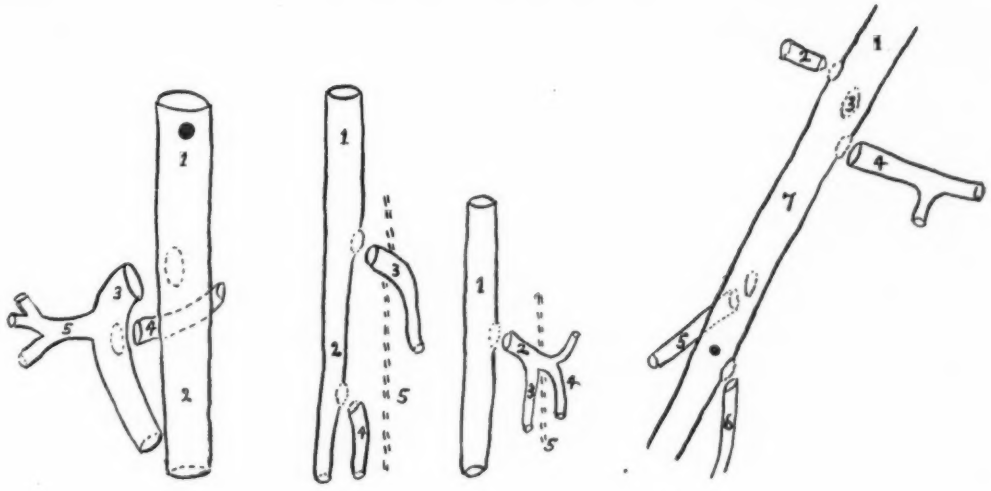

Fig. 52. Drawings illustrating special regions in the extremities likely to cause trouble in operation for traumatic aneurism due to bullet injuries and to explain them.

a. *1*, Common femoral artery (right); *2*, superficial femoral artery; *3*, deep femoral artery; *4*, internal circumflex artery; *5*, external circumflex artery.

b. *1*, Popliteal artery from the outer side; *2*, posterior tibial artery; *3*, anterior tibial artery; *4*, peroneal artery; *5*, interosseous membrane.

c. *1*, Ulnar artery; *2*, common interosseous artery; *3*, anterior interosseous artery; *4*, posterior interosseous artery; *5*, interosseous membrane.

d. *1*, Axillary artery; *2*, anterior circumflex artery; *3*, posterior circumflex artery; *4*, subscapular artery; *5*, superior profunda artery; *6*, inferior profunda artery; *7*, brachial artery.

Illustrations from report of author's case. *Brit. J. Surg.*, i, 1915, No. 10.

terrors of war wounds and there are many points in connection with these cases still open to discussion and settlement. Some figures given to me by Major D'Oyly Grange for cases on which he operated, support a view expressed by me, with particular reference to traumatic aneurisms, and illustrated by him in the *British Journal of Surgery*.

"The escape of an artery from a bullet is due to its elasticity and mobility. At points where branches arise the artery is tethered by them, so that it becomes fixed and is pierced by the impact of the bullet, and the branches are either torn through or caught and divided." (Fig. 52.)

Major Grange's cases include 50 from arteries; 2 from the popliteal vein. Of these 30 vessels were tied at the site of injury. Of the thirty in which the bleeding point was seen and tied, 22 were close to branches of the artery.

There is one rule which should never be neglected, and that is to open up the wound freely, and expose the bleeding area in every case. Packing through the wound will often suffice to stop temporarily a small hæmorrhage, but it so often recurs later that this should only be regarded as preliminary to a complete operation. Free opening and inspection with a good light may readily discover bleeding from a large vessel, and then Guthrie's instructions can be followed, and the vessel tied above and below the opening. If no large vessel is bleeding the wound should be "bipped," and left open with gauze pack. It is not so easy to decide what is to be done if bleeding recurs, but I believe the main artery should be tied above the wound, as close to it as it is possible to find an uninfected spot, and the wound should be "bipped" and packed again—this packing being left in for more than 2 weeks.

In twelve of Major Grange's 50 cases, the vessel was tied above the seat of injury and the wound was packed; 8 wounds were simply packed. In the whole series there were 7

deaths: 2 before operation; one during operation; one from sepsis four days after operation; one from septicæmia after hæmorrhage from the popliteal vein. No case died from recurring hæmorrhage after operation for hæmorrhage.

Every surgeon who has done vascular surgery must recognize the uncertainty of it. A very trifling interference will cure one aneurism; another of the same vessel, and having similar characteristics, but in a different individual, possesses all the malignancy of a cancerous growth. In two persons, apparently similar cases, the results may be widely different. After ligature of the main trunk in one there may be no circulatory disturbance, while in the other there may be gangrene of the limb below. In hæmorrhage the same uncertainty applies. Theoretically, ligature of the main trunk above an indiscoverable bleeding point should cause gangrene if it arrests the bleeding; but, practically, the bleeding usually stops and gangrene of the limb does not often occur. In the exceptional case, bleeding is not arrested, and gangrene follows ligature of the vessel above.

BONE INFECTIONS

One of the surprises of the war has been the rarity of pyæmia after bone infections.

Acute pyæmia followed by death, no infrequent result of bone infections in civil life, has been almost unknown in war surgery. Subacute forms of it, with comparatively mild joint infections have been less rare, but even these have been uncommon. The chronic variety of pyæmia, leading to ankylosis of many joints and recovery with serious crippling, I have not seen at all.

More or less bone infection has followed most of the fractures that have been sent to this country, and they have arrived already infected. The consequence has been much bone necrosis, and a large amount of our surgery has been for the removal of sequestra. The subject is too large for discussion now, but it is so important that I hope it will be fully dealt with elsewhere in the near future. Bone sepsis, as I know it, is a much more serious thing than is generally realized, and in many of the cases I have seen, it has been the cause of a painful and lifelong disability. An infected bone, either following a septic compound fracture or of the blood infection variety, may apparently recover, but from time to time fresh trouble recurs in it, and painful attacks of inflammation lead to sclerosis, or more or less destruction of the bone. One patient I saw had had such an attack in one or other of his long bones almost every year, from the age of 13 to 73, when I last saw him. I have seen many other instances of this. It would seem that the staphylococcus, having once acclimatized itself to the skeleton and long bones, has a special tendency to locate itself in these. It is too early yet to say what percentage of our healed cases will have further general or local trouble after infection of their bones, but several which appeared to be soundly healed, have returned after weeks or months with renewed local mischief.

BONE CAVITIES

There are numbers of men going about incapacitated by discharging bone cavities, and every surgeon has found them difficult problems to tackle when the holes were of good size and in positions where it was impossible to chip away the edges and flatten them out. Those in the lower end of the femur, the upper end of the tibia, the os calcis, the ilium and the upper end of the humerus occasion most trouble. (Figs. 12 to 19.)

We have now found that we rarely fail to secure healing by the use of "bipp" and fat grafts, and I am going to show X-ray pictures of some cases, before and after operation (Figs. 20 to 22). Unfortunately, in some cases, though very few so far as I know, healing has occurred, but weeks or months later an abscess has formed and discharged, leaving a sinus communicating with the cavity, and the work has had to be done over again. As a rule these cavities promptly heal, and the fat packing is replaced by bone.

BONE GRAFTS

There is no more satisfactory surgery to be done than bone grafting, and though there is much in detail yet to be learned about

it, the principles governing the use of bone grafts are now so well understood that it is safe to say that failure to secure satisfactory results is due to faulty technique.

All surgeons who know anything about it, agree that asepsis is of the greatest importance, and that the graft should be firmly fixed and held in contact with a raw surface of living bone, until union has occurred.

Albee teaches that grafts must *never* be placed in scar tissue, and that they must not be fixed by any unabsorbable material. One of my illustrations shows a new radius, which has grown from a graft lying in a bed of dense scar tissue, so little vascular that I had small hope of a good result. (Figs. 36 to 43.) In several cases I have used Lane's plates with success (Figs. 23 to 35), and until I find that I am mistaken, will continue to believe that there is no other means so well calculated to secure efficient immobilization, provided the bones are hard enough to hold screws. If scarred skin flaps are used to cover grafts they are apt to break down and expose the bone. This result may generally be prevented by crisscross superficial incisions, which avert œdema and tension of the scar tissue.

Before operating in the presence of scars, our rule is that they should either be excised and replaced by transplanted flaps, or should undergo a course of radiant heat for 10 to 14 days in preparation. We learned this from A. E. Morison. Our records show that 10 per cent of the earlier cases in the Northumberland War Hospital developed abscesses or broke down, when their scars were exposed to radiant heat. If they remain healthy after 10 days of this treatment we are confident that infection from the old wound will not follow operation.

The illustrations show methods I have employed to secure contact between the graft and the bone.

PRIMARY SUTURE OF GUNSHOT WOUNDS

With Some Remarks upon the Application of Similar Principles in Civil Surgery[1]

By SUMNER L. KOCH, M.D., Chicago

OF the surgical advances which the experiences of the war have brought to us, one of the most important, from the standpoint of the civil surgeon, seems to us the knowledge that, under appropriate conditions, recent infected wounds may be excised, surgically cleansed, and sutured, with the confident expectation of primary healing in 85 to 90 per cent of cases. The following series of cases is reported as an illustration of the results obtained in late primary excision and suture of gunshot wounds, with the conviction that the same methods may be applied with equal or greater success by the civil surgeon in the accidents and emergencies of civil and industrial surgery.

At the very outset of the war, primary excision followed by immediate suture was recognized as a valuable method of treatment of gunshot wounds, and was successfully applied by various French and Belgian surgeons. When attempted on a wider scale and under more or less unsuitable conditions, a number of disastrous results followed, with the result that the method was temporarily abandoned in favor of various "antiseptic" methods of treatment. Gradually, as Sir Anthony Bowlby (1) has shown, as the essential conditions for success were realized, and as a more perfect organization permitted their fulfillment, the method was more and more widely used, in cases of increasing severity, and with constantly improved results.

Many different surgeons took a prominent part in this development: Gross (2), and his associates (3), Lemaitre (4), Duval (5), Marquis and his associates (6), LeGrand (7), Potherat (8), Huguet and his associates (9), of the French medical service; Gray (10), Drummond and McNee (11), Haycraft (12), Morrison, Hartley and Bashford (13), Fraser, Stokes and Tytler (14), of the British and Canadian medical services; Cushing (15), Crile (16), Brock (17), of the American medical service, as well as many others, the results of whose work are not available at the present moment.

During the summer and autumn of 1918, a concerted effort was made throughout the British base hospitals to apply at the base the methods which these leaders so successfully applied at the front. Colonel Owen Richards, consulting surgeon to the British base hospitals at Camiers, Lieutenant Colonel Hugh Cabot of 22 General Hospital, Colonel F. A. Besley, Major P. L. Nusbaum, and Major M. R. Chase of 18 General Hospital (American Base Hospital 12), and Colonel G. W. Crile of 9 General Hospital (American Base Hospital 4), among many others, lent their influence and took an active part in accomplishing results which seemed to us to mark a distinct step forward in the surgical work of the base hospitals.

The splendid results reported by Lemaitre, Gross, Duval, Fraser and others take on greater significance when it is remembered that they operated upon a much higher proportion of *severely wounded* cases than did the surgeons at the base. During periods of stress it was the patients with the *slighter* wounds, those who were considered as being able to travel safely without operation, that were sent to the base. On the other hand, in the advanced areas, the surgeons were able to operate upon their cases within a relatively short time after the receipt of injury. Duval's (5) cases were operated upon at an average interval of 7 to 8 hours after being wounded. He considered an interval exceeding 12 hours between the time of injury and operation as a contra-indication to primary excision and suture. Gross' (2) cases were operated upon after an average interval of 8 to 10 hours. He considered 12 to 18 hours as the maximum interval. Fraser's (14) cases were operated upon at an average of 11.7 hours after being wounded.

[1] From the Surgical Division, Base Hospital 12

In the present series, cases were operated upon 36, 48, and even 72 hours after being wounded, with results which before the summer of 1918 we would have considered impossible of attainment. One hundred forty-one cases with 161 wounds, 81 of them with retained foreign bodies, were treated by primary excision and suture at an average of 49.81 hours after the receipt of injury. Of the 161 wounds, 116 were flesh wounds; 45 were complicated by bone, joint, nerve or tendon injury. Of 116 flesh wounds, 99 (85.3 per cent) were completely successful (Figs. 1 to 4); 11 (9.5 per cent) were partially successful; 6 (5.2 per cent) were complete failures. Of 45 complicated wounds, 26 (57.7 per cent) were completely successful; 17 (37.7 per cent) were partially successful; 2 (4.6 per cent) were failures. Of the total, 77.6 per cent were completely successful; 17.4 per cent were partially successful; 5 per cent were failures.

The series of cases reported here represents only a small proportion of the cases similarly treated at 18 General Hospital (American Base Hospital 12) with equally good or better results. Major P. L. Nusbaum, Major M. R. Chase, Captain G. N. Krost, Captain J. J. Lebowitz, Captain J. F. Jaros, Captain E. O. Ravn, Captain C. J. Glaspel, Captain H. L. Baker, Captain C. W. Robertson, Captain E. R. Talbot, Captain R. W. Eaton, and Captain W. L. Siewerth shared in this phase, as well as in the other surgical work of the hospital, in a way and with results that elicited fine commendation from the British authorities under whom they were serving.

In the treatment of uncomplicated flesh wounds the technique followed was that consistently recommended by surgeons of wider experience: careful cleansing of the skin about the wound, complete excision of the damaged tissues, and careful coaptation of the skin edges in suturing, with obliteration of dead spaces by deep sutures. Every effort was made to excise as narrow an edge of skin as possible at the margin of the wound, in order to obviate tension on the superficial tissues in closing the wound. In gutter wounds and superficial wounds, when possible, the damaged tissue was excised *en masse* without permitting the scalpel to enter the contaminated field. When this was possible, no antiseptics were left in the wound. Where the damaged tissue had to be removed piecemeal, the wound was swabbed before suturing with methylated spirit. In a few cases a small piece of rubber glove drain was left in one corner of the wound and removed 48 hours after operation. No dye solutions were used to stain the damaged tissue.

The treatment of complicated wounds obviously offered more difficulties than that of flesh wounds, but the principles, as has so frequently been pointed out, were the same: complete excision, with removal of all foreign bodies and devitalized tissue. In the treatment of head wounds the suggestions outlined by Cushing (15) were carried out: operation under local anæsthesia, removal of the injured bone *en bloc*; in penetrating wounds aspiration of the disorganized brain tissue and blood clots with a soft rubber catheter, careful removal of bone fragments and foreign bodies, and gentle irrigation of the cavity with salt solution. In the treatment of bone injuries all bone fragments were removed subperiosteally with sharp periosteotomes, the rugines of Ollier, as recommended by Leriche and his associates; and every attempt made to remove all the tiny bone fragments invariably driven into the soft tissues about the site of fracture. In these cases, following the primary operation, the wound was usually packed with paraffin gauze or flavine gauze, and at the end of 48 hours a "delayed primary suture" carried out under nitrous oxide anæsthesia. This delay, with the resulting decrease of swelling and œdema, sometimes permitted suture in cases in which it would have been impossible at the primary operation

Following the suggestions of Captain Fraser and numerous other writers, every attempt was made at complete immobilization of the wounded part following operation. Most wounds of the arm, forearm and hand were splinted; all wounds of the upper extremity were placed in a sling. Entry and exit wounds of the thigh or leg, and all wounds about the knee were placed in a Thomas or right angled leg splint. The majority of

patients were kept in bed for several days at least; those with wounds of the lower extremity, until healing was complete.

Wounds were not dressed for 72 hours if the patients were comfortable and the temperature not alarming. Except in those cases which were complete failures, the patients complained very little; they slept, ate well; in few cases did they require any sedative aside from the one-fourth grain of morphine given before operation. In those cases which were retained, a part of the sutures were removed at the end of 10 days, the remainder at the end of 14 days. It was not possible to retain all cases for 14 days; some were evacuated at the end of 7, 8, and 10 days. In those cases the sutures were left in place and immobilization maintained.

The successful cases need no comment. Sir Anthony Bowlby (1) has pointed out the tremendous advantages of successful primary excision and suture; from the standpoint of the patient, as to time, as to freedom from pain and suffering, as to ultimate function; from the standpoint of the hospital and staff in the tremendous reduction in labor, dressings and postoperative care; and from the standpoint of military efficiency.

With reference to the partially successful uncomplicated cases, we felt that in no case had the patient not gained by the attempt to excise and suture the wound. In no case was it necessary to completely open the wound and resort to active counter measures to combat the infection. In three cases, one or two sutures were removed to permit the escape of localized pus. Following this, the wounds cleared up rapidly. In four cases there was superficial infection not involving the depth of the wound. In one case, which was dry until the stitches were removed, there was a discharge of thin yellow serum for three or four days following the removal of the sutures. This disappeared completely at the end of that time. In three cases, due to tension, there was considerable separation of the skin edges, which was accompanied by a slight purulent discharge, following the removal of the sutures.

Of the six failures, five were due to infection by hæmolytic streptococci.

In the first case there was a slightly infected wound near the midline of the neck. A small foreign body was localized near the right common carotid artery. The entry wound was excised on the fifth day, the track followed for some little distance and then lost. The patient was taken into the X-ray room, and the foreign body was seen to be very small, lying 2.5 inches from the wound of entry. The wound was sutured without further treatment. Twenty-four hours later the patient's temperature was 102.6°; his neck was brawny and swollen, and he complained of intense pain and difficulty in swallowing. The sutures were removed immediately, liberating a small quantity of thin pus which showed numerous hæmolytic streptococci on culture. The symptoms subsided promptly thereafter, and two weeks later the wound had healed.

In the second case, there was a wound of the abdominal wall just below the umbilicus, which had been excised and sutured 44 hours after the receipt of injury. A foreign body had apparently been removed nearer the front, but the bottom of the wound, which did not involve the peritoneal cavity, was still filled with dirt and cloth. The wound, extending into the right rectus muscle, was completely excised and sutured. Thirty hours later the patient's temperature was 99.8°, and he complained of much abdominal pain. The wound was examined and a thin, dark brown, turbid fluid found oozing from between the sutures. All the sutures were removed, and two-hourly irrigations with Dakin's fluid started at once. The patient's temperature promptly fell to normal and the subsequent course was uneventful. Culture of the discharge made by Captain W. S. Gibson showed large numbers of hæmolytic streptococci.

In the third case there was a deep, badly infected gutter wound of the right deltoid region, which was completely excised and sutured 37 hours after the receipt of injury. Sixteen hours later the patient's temperature was 102.8°, his pulse 110, and he looked very ill. The tissues about the wound were brawny and reddened, thin pus was beginning to ooze from between the sutures. The sutures were removed immediately, and Carrel-Dakin treatment started. The temperature fell rapidly, and Carrel-Dakin treatment was discontinued on the sixth day.

In the three remaining cases there were superficial wounds; in one, of the neck; in two, of the forearm; operated upon 48, 66, and 48 hours respectively after being wounded. Clinically they presented the same appearance as many other wounds which had been successfully sutured. In all three a seropurulent discharge appeared within 48 hours, which in two cases showed hæmolytic streptococci on culture.

COMPLICATED CASES

The 45 cases complicated by bone, joint or tendon injury included:

11 cranial wounds —with extensive extradural hæmorrhage, 3 with dural penetration—;

Fig. 1. Case 10. Gutter wound of inner aspect of right elbow with large foreign body and cloth lodged at one end of the wound. Completely excised and sutured 46½ hours after receipt of wound.

This patient also had small gutter wounds of the right shoulder and chest wall, and two wounds of the right hand with retained foreign bodies and with a fracture of the unciform bone, one foreign body having passed almost completely through the ulnar side of the carpus. All the wounds were excised, the foreign bodies removed from the hand, and the wounds sutured. Thirteen days later, Captain Lebowitz noted: "Sutures removed. Primary union in all wounds except for superficial stitch abscess of one wound of the hand."

Fig. 2. Case 24. Badly infected gutter wound of scalp, without bone injury, excised and sutured 41½ hours after receipt of injury. Healing complete on the twelfth day.

5 facial wounds with fractures of one or more bones of the face;

1 with fracture of the hyoid;

1 with fracture of the sternum and ribs;

2 with fractures of the scapula;

2 with fractures of the humerus;

4 with fractures of the radius, including one with partial and one with complete division of the median nerve;

2 with fractures of the ulna, including one with complete division of the ulnar nerve;

2 with fractures of the carpus;

5 with fractures of the bones of the hand, including two with division of the extensor tendons;

1 with fracture of the sacrum;

1 with fracture of the fibula;

1 with fracture of the calcaneus;

1 with penetration of the shoulder-joint;

1 with penetration of the wrist-joint;

3 with penetration of the knee-joint;

2 with division of extensor tendons of hand.

1. *Cranial wounds.* Of the 11 cranial wounds, 1 was associated with extensive extradural hæmorrhage, 7 with depressed fracture without dural penetration, and 3 with extensive injury of the bone and dura.

The first case entered the hospital four days after being wounded, with a shallow laceration of the scalp over the left parietal area, and without evidence of cranial injury. On getting out of bed on the seventh day he developed a severe generalized convulsion lasting five minutes. Six hours later he had a similar convulsion, followed by partial loss of consciousness, and partial paralysis of the right facial nerve. Four hours later, under local anæsthesia, the wound was excised, and from underneath a linear fracture of the frontal and left parietal bones an extensive extradural clot was evacuated. The bleeding vessel, a branch of the anterior division of the middle meningeal artery, was ligated. The dura was incised, and a considerable amount of blood-tinged cerebrospinal fluid under tension permitted to escape. The dura and scalp were sutured. The day following operation the patient had two more severe, generalized convulsions. Lumbar puncture showed a normal spinal fluid with no increase of tension. Recovery thereafter was slow and uneventful. The wound healed by primary union. The weakness of the right facial muscles was considerably less marked when he was evacuated three weeks after operation. There were no other objective symptoms.

The 7 cases without dural penetration were operated upon at an average interval of 61 hours after being wounded, the shortest interval elapsing between the receipt of wound and operation being 28 hours, the longest 83 hours.

In 3 cases the frontal region was involved; in 1 the mid-line over the longitudinal sinus; in 1 the left parietal region; in 2 the occipital region.

Fig. 3. Case 26. Entry and exit wounds of the posteromedial aspect of the left calf, completely excised 37½ hours after injury, packed with paraffin gauze, and sutured 72 hours later by Captain Glaspel. Healing complete at the end of 6 days. The patient's temperature was not higher than 99.2° at any time following operation.

Fig. 4. Case 37. Partial success. Flesh wound of flexor muscles of right forearm, operated upon 33½ hours after injury. When the dressings were first removed from the wound the dirty contused muscle stood out 1¼ inches above the surrounding tissues, and the case looked hopeless as far as suture was concerned. Photograph 17 days after operation. The patient's temperature did not rise above 98.8° throughout the postoperative course.

In the first 5 cases the dura pulsated following the removal of the depressed bone. In the latter 2, the dura was tense, and pulsation was absent. In both, considerable dark fluid blood and a small amount of necrotic brain tissue was evacuated on incising the dura. In all except the last case, the wounds healed by primary union. In the last case a part of the sutures were removed on the third day and the wound discharged serosanguinous fluid for eight days. There were no further complications.

In the ninth case there was a dirty wound of the right side of the forehead with extensive loss of bone and brain substance. Because of the apparent hopelessness of the case and the stress of work, no operation was attempted until the evening of the day following his admission, 67 hours after the receipt of the wound. At that time the scalp wound was excised, the damaged brain tissue washed away, and the scalp sutured. No dural covering could be brought over the exposed brain tissue. On the ninth day following operation, the patient was rational for the first time. On the twelfth day the wound, which had opened at the lower angle and become slightly infected, began to discharge clear cerebrospinal fluid. This continued intermittently until the twenty-eighth day when the patient was evacuated, rational, with normal temperature, and with the wound healed except for two small openings which still discharged cerebrospinal fluid.

In the tenth case there was a penetrating wound of the left frontal region, operated upon 83 hours after the receipt of injury. X-ray examination showed a penetrating wound of the cranium, with a small foreign body located rather superficially, and bone fragments scattered along a wound tract two and one-half inches deep. The wound was foul; the patient comatose, with a complete paraplegia, and incontinence of the bowel and bladder. The wound was excised, the foreign body and many loose fragments of bone removed, the wound in the brain carefully irrigated with salt solution, and the damaged brain tissue and blood aspirated with a soft catheter. The scalp was sutured. Following operation the patient improved for five days, during which time his fever steadily receded. On the evening of the fifth day his temperature rose to 103°, and symptoms of meningitis appeared. He died on the seventh day.

The eleventh case was admitted 60 hours after being wounded, and operated upon 12 hours later. The notes on his field card were as follows:

". . . Field Ambulance. 'Unconscious at advanced dressing station.'

". . . Casualty Clearing Station. 'Hemiplegia. Unconscious.'

". . . Ambulance Train. 'Dirty wound found in region of left elbow. Dressed.'"

X-ray examination showed a retained foreign body at a depth of 6 centimeters from the entry wound in the left frontal region. At the time of operation the patient was comatose, with complete paraplegia. He also had a dirty wound of the left elbow with a compound fracture involving all three bones. Under local anæsthesia the scalp wound was excised, the wound cleansed, and an unsuccessful attempt made to remove the foreign body with the magnet. The wound was sutured. With the aid of a few whiffs of chloroform, a large piece of shrapnel was removed from the elbow, and the wound partially excised. The patient died 7 hours later, without regaining consciousness.

The latter two cases represent the only fatal cases in the series.

2. *Wounds of the face.* Of five different wounds associated with fracture of one or

more of the bones of the face, four healed by primary union.

The first was accompanied by a fracture of the right malar bone and of the pterygoid plate of the sphenoid. A small foreign body had passed through the latter and lodged in the right infratemporal region. The bone fragments were removed, the foreign body not found. The wound was excised and sutured. The second was accompanied by a fracture of the malar bone, the third by a fracture of the right maxilla and ethmoid (Fig. 5), the fourth by a fracture of both maxillæ. All four were excised and sutured, 34, 36, 32, and 30 hours respectively after being wounded. From three, foreign bodies were removed. All healed by primary union. In the fifth case there was a comminuted fracture of the mandible with a small opening into the oral cavity. The wound was excised, a deformed machine-gun bullet and many loose bone fragments removed, the opening into the mouth closed by a suture, and the external wound sutured. The operative wound healed rapidly, but five days after operation a swelling appeared in the midline of the neck just above the hyoid bone. This was incised and a small quantity of thick foul pus evacuated. The discharge cleared up rapidly, and the further course was uneventful. The operative wound healed by primary union.

3, 4. *Fracture of the hyoid. Fractures of the sternum and ribs.* 55 and 28 hours. These both healed by primary union.

In the latter case a shrapnel ball had ploughed across the anterior aspect of the chest wall fracturing the right fourth rib, the sternum, and the right fifth rib without penetrating the pleural cavity. Following operation, the patient's pulse became very rapid and irregular, he became cyanotic, and for some hours remained in a state of profound shock. No treatment was given except morphine and the application of artificial heat. Six hours later he was resting comfortably, and thereafter showed no signs of cardiac or respiratory embarrassment.

5. *Fractures of the scapula.*

In the first case, operated upon 34 hours after being wounded, sutures were put in place at the primary operation, to be tied within 48 hours. They were overlooked, and when the paraffin pack was removed and the sutures tied on the sixth day the edges of the wound had already become covered with epithelium, thus preventing complete healing by primary union. There was no macroscopic infection. In the second case, 38 hours old, a slight discharge appearing three days after operation necessitated the removal of two sutures, permitting the wound to gape in the center. There was no gross infection and recovery was uneventful following the removal of the sutures.

6. *Fractures of the humerus.* Both of these were only partially successful.

Fig. 5. Case 50. Gunshot wound of the face, with compound fracture of the right maxilla and of the ethmoid, involving both the nasal and oral cavities. Wound excised, foreign body and bone fragments removed, and wound sutured, 32 hours after injury. Primary union.

In the first, operated upon 32 hours after being wounded, there was an entry and exit wound with extensive comminution of the upper one-third of the humerus. Both wounds were excised, the loose bone fragments removed, and the wounds sutured. The following day the patient's temperature was 101.8°, and the arm was considerably swollen. Twenty-four hours later two sutures were removed from the posterior wound and a small quantity of thin pus liberated. Following this the temperature receded and further progress was uneventful. The anterior wound healed by primary union. The posterior wound was clean and granulating when the patient was evacuated 18 days after operation.

In the second case, involving the lower one-third of the humerus, the anterior entry wound was excised, the bone fragments removed, and a deformed machine-gun bullet removed through a posterior counter incision. The posterior wound was sutured, the anterior wound packed with paraffin gauze. A moderate amount of thin discharge followed the removal of the pack after 48 hours. This cleared up after eight days without special treatment, when suture was completed.

7. *Fractures of the radius.* Two of these (Figs. 6 and 7) were completely successful.

The third case, with partial division of the median nerve, was operated upon 40 hours after being injured, and sutured 48 hours later. A slight dis-

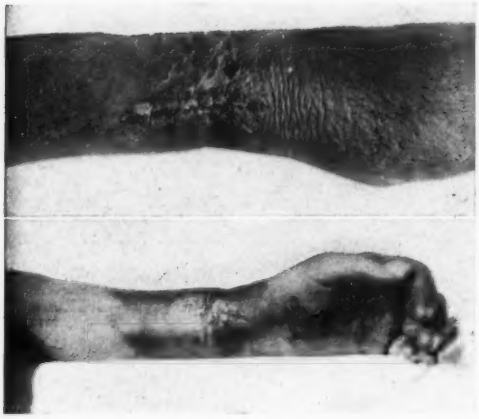

Fig. 6. Case 72. Entry and exit wounds of the left forearm with comminuted fracture of the radius, excised 63½ hours after the receipt of injury, loose bone fragments removed, and wounds packed with paraffin gauze. Forty-eight hours later the packs were removed, but the wounds only partially sutured because of tension. Five days later four sutures were added, and three days later suture was completed. Healing was complete on the ninth day following, when the sutures were removed.

charge and separation of the skin edges appeared four days later. The discharge disappeared after a few days, and the wound was clean and granulating when the patient was evacuated. At no time following operation was his temperature above 99.6°. The fourth case, an entry and exit wound with complete division of the median nerve, was operated upon 37 hours after being wounded. Three days later the dorsal wound was sutured, but only two sutures could be placed in the volar wound, because of the extensive loss of superficial tissue. The dorsal wound had healed, the volar wound was clean and granulating when he was evacuated to England thirteen days after operation.

8. *Fractures of the ulna.*

The first case was operated upon 45 hours after receipt of injury, the wound excised, the bone fragments removed, and the wound packed with paraffin gauze. Forty-eight hours later the wound was sutured. The patient's temperature never rose above 99.6° following operation, but there was a slight discharge following the removal of the sutures on the thirteenth day. This disappeared completely before the patient was evacuated.

In the second case, operated upon 40 hours after being injured, and sutured 48 hours later, the ulnar nerve had been completely divided, and a considerable amount of superficial tissue lost. From the excessive tension the skin edges became slightly separated following the removal of the sutures, but the wound remained clean throughout.

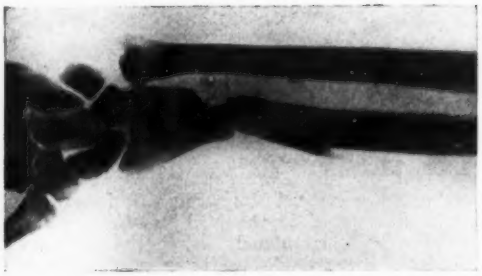

Fig. 7. Case 72. Roentgenogram of forearm ten days after operation.

9. *Fractures of the carpus.*

In the first case, operated upon 53½ hours after injury, a machine-gun bullet had passed from the palmar surface through the unciform bone and lodged in the soft tissues of the dorsum of the hand. Recovery following operation was uneventful, and the patient's temperature remained normal throughout.

In the second case, operated upon 46 hours after injury, a small stitch abscess developed about one of the sutures. The temperature remained normal throughout, and recovery otherwise was uneventful.

10. *Fractures of the bones of the hand including two with division of the extensor tendons.* Four of these, operated upon 32, 34, 36, and 66 hours respectively after being wounded, were completely successful.

In the fifth case, operated upon 30 hours after injury, the right thumb had been shot away, leaving a short stump which was amputated at the metacarpophalangeal joint. The amputation wound became slightly infected, necessitating the removal of two sutures.

11. *Fracture of the sacrum.*

In this case, a shrapnel ball had penetrated the pelvis through the right buttock, passing through the sacrum and lying just in front of it near the midline. It was removed with considerable difficulty 36 hours after injury; the wound was excised, the bone fragments removed, and the wound sutured. The patient's temperature is shown on the accompanying chart (Fig. 8). There was a thin yellowish discharge on the dressings for 4 or 5 days after operation, but the sutures were all left in place, and the wound was completely healed on the tenth day.

12, 13. *Fractures of the fibula and calcaneus.*

These cases were operated upon 33 and 40 hours respectively after being wounded. In both cases, foreign bodies were removed, and in both healing took place by primary union.

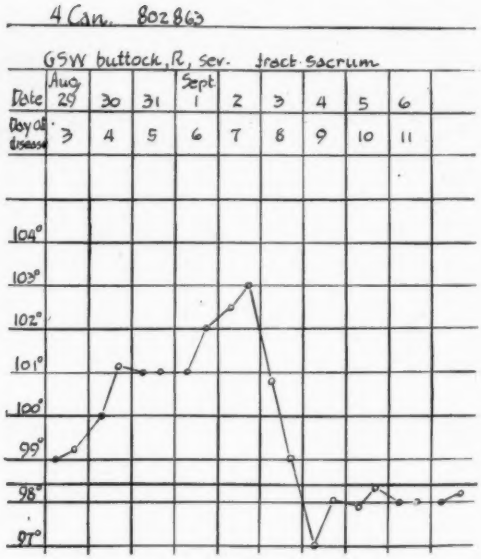

Fig. 8. Case 77. Shrapnel ball penetrating pelvis through right buttock, and fracturing sacrum. Wound excised, shrapnel ball removed, and wound sutured 36 hours after injury. Thin, yellowish discharge on dressings for 4 or 5 days; rise of temperature to 103° on the fifth day; thereafter uneventful recovery. Healing by primary union.

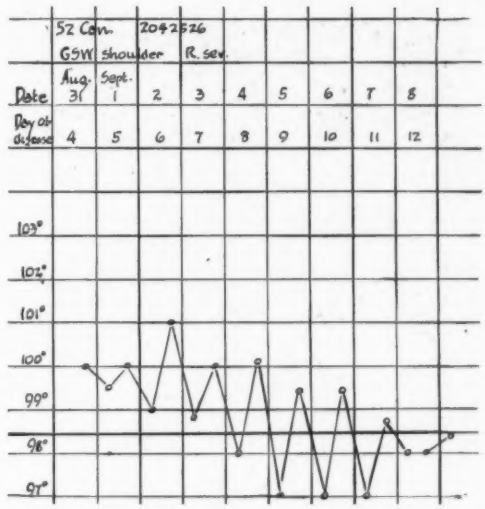

Fig. 9. Case 97. Three dirty wounds with retained foreign bodies about the right shoulder, including one which had penetrated the joint cavity. Two wounds, including the one involving the joint, were excised, the foreign bodies removed, and the wounds sutured 78 hours after injury. The third wound, which extended deeply behind the clavicle, was excised, two foreign bodies removed, and the wound loosely packed with paraffin gauze. The sutured wounds healed by primary union. The third wound discharged thin serous fluid for a few days.

14. *Penetrating wound of the shoulder-joint.*

This patient, operated upon 78 hours after injury, had three dirty wounds about the right shoulder. His temperature at the time of operation was 100°. The first wound, in the supraclavicular triangle, was very deep, the track running downward and forward behind the junction of the outer and middle thirds of the clavicle. Two foreign bodies and some cloth were removed, the wound was excised and packed with paraffin gauze. Through the second wound, on the outer aspect of the shoulder, a small foreign body had penetrated the joint cavity, leaving a dirty infected track. The wound track was carefully excised, the foreign body removed, and the wound sutured without attempting to suture the capsule itself. The third wound was comparatively superficial. It was completely excised and sutured. Following the removal of the paraffin pack from the first wound, 48 hours later, there was a slight thin discharge which continued for several days. The other wounds healed by first intention. The patient's temperature is shown on the accompanying chart (Fig. 9).

15. *Penetrating wound of the wrist-joint.*

A small foreign body was removed from the left wrist-joint through the excised entry wound on the dorsum of the wrist, 48 hours after injury. The joint capsule and skin were sutured immediately. The patient's temperature was never above 99.8° following operation, and healing took place by primary union.

16. *Penetrating wounds of the knee-joint.*

The first patient was operated upon 78 hours after being wounded. One piece of shrapnel, 1 by 0.5 centimeters had penetrated the right knee-joint, fracturing the patella longitudinally; a second piece lay below the patella, buried in the quadriceps tendon. The knee-joint was filled with bloody fluid; the synovial membrane was of a dark mottled red color, intensely congested and œdematous. Both wounds were excised, the foreign bodies removed; the periosteum of the patella was sutured, the joint cavity closed, and the external wound sutured. There was some effusion into the joint cavity following operation and the patient's temperature remained at 101.2° to 101.4° for several days. The effusion gradually disappeared, the fever subsided, and recovery was absolutely uneventful.

The second case was operated upon 56 hours after being wounded (Fig. 10). A small shrapnel splinter had penetrated the joint cavity and stuck in the articular cartilage of the femur. The wound was

Fig. 10. Case 102. Gunshot wound of left knee, operated upon 56 hours after being wounded. The wound was excised, considerable thick, blood-stained fluid evacuated from the joint cavity, the foreign body removed, the joint capsule and wound sutured. Healing by primary union.

This patient had also penetrating wounds of the left groin, left heel, left foot, right thigh, and lacerated wounds of both hands. Foreign bodies were removed from the three former as well and the wounds successfully excised and sutured.

excised, and considerable thick, blood stained fluid evacuated from the joint cavity. The foreign body was removed, the joint capsule and wound sutured. Recovery was uneventful. (This patjent had also penetrating wounds of the left groin, left heel, left foot, right thigh, and lacerated wounds of both hands. Foreign bodies were removed from the three former as well and the wounds successfully excised and sutured.)

The third case was operated upon 48 hours after the receipt of injury. The wound of entry on the outer side of the left knee-joint was excised, the track followed into the joint cavity, but the foreign body shown on radiographic examination not found. The wound was sutured. Three days later thick serosanguinous fluid was found oozing from between the sutures. The patient's temperature was 100° to 101°. He was taken to the operating room the same evening, and the foreign body, deeply buried in the crucial ligaments, removed through the original wound by the aid of the fluoroscope. A counter incision was made on the inner side of the joint and two Carrel tubes inserted in either side of the joint cavity. Two-hourly irrigation with Dakin's fluid was carried out for four days, when

Fig. 11. Case 107. Gutter wound of left hand with division of extensor tendons of index finger and tendon of extensor carpi radialis brevis. Wound excised, tendons sutured, wound closed, 30 hours after receipt of injury. Primary union. Photographs before, and 6 days after operation.

the tubes were removed and the wound permitted to heal by granulation. Recovery was slow but uneventful.

In view of the many successful results obtained even later in knee-joint injuries, we felt that if the foreign body had been removed at the primary operation the wound would have healed without reaction.

17. *Division of the extensor tendons of the hand.*

These cases were operated upon 36 and 30 hours respectively after injury. In the first, the extensor tendons of the index finger were divided by a gutter wound on the dorsum of the carpus. In the second (Fig. 11), the extensor tendons of the index finger and the extensor carpi radialis brevis were divided. The wounds were excised and the tendons and wounds sutured. In both cases there was primary healing.

DELAYED PRIMARY SUTURE

Simultaneously with the above series of cases we were able to observe the equally successful results of a number of cases of delayed primary suture, for which, however, we can claim little credit, as the important part of the operation—the primary excision—was done elsewhere, and the cases evacuated to us for suture and postoperative care.

In this series there were 34 cases with 37 wounds excised on an average of 16.3 hours after the receipt of the wound, and sutured

Fig. 12. Case 156. Entry and exit wounds of the left arm with comminuted fracture of the humerus. Wounds excised, loose bone fragments removed, wounds packed with flavine gauze at the front, 9 hours after the receipt of injury. Five days later the packs were removed and both wounds sutured at the base.

Photograph 15 days later; lateral wound completely healed; slight serous discharge from medial wound. (The apparent pressure on the arm from the splint is due to the temporary elevation of the arm to permit a view of the dorsomedial aspect.)

on an average of 62.6 hours after the primary excision. Of these, 31 were completely successful, 3 were partially successful, 3 were failures. Of the wounds 27 were uncomplicated flesh wounds, 9 were complicated by bone or tendon injury, 1 involved the ankle-joint. Of the complicated wounds 3 were associated with fracture of both bones of the forearm, 1 with fracture of the radius, 1 with fracture of the ulna, 1 with fracture of the humerus (Figs. 12, 13), 3 with fracture of the metacarpals and division of the extensor tendons.

In 13 cases the wounds had been packed with gauze saturated with flavine solution. This number included the three partially successful cases and one failure. Five cases had been "bipped," and one packed with eusol gauze. These all healed by primary union.

The three failures followed ill-advised attempts at the beginning of our experience to suture flesh wounds in which there was mac-

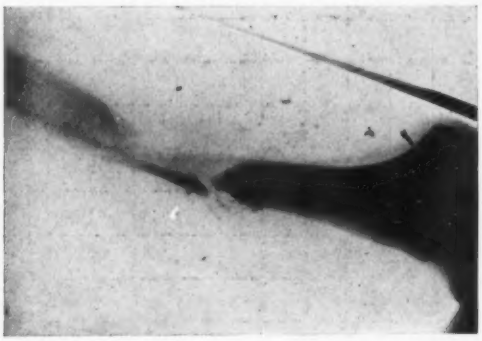

Fig. 13. Case 156. Roentgenogram taken 12 days after injury.

roscopic evidence of infection upon the removal of the original dressing and gauze pack. In one case the original excision had been carried out four days previously, and suture was attempted by way of experiment. In all three cases cultures of the wounds made by Captain W. S. Gibson at the time of suture showed profuse growths, and within 48 hours pus began to ooze from between the sutures, necessitating their removal.

The partial successes occurred in cases where it was impossible to completely close the wound because of tension on the superficial tissues. These included two flesh wounds and a third with involvement of the ankle-joint. In none of them was there macroscopic evidence of infection, and the uncovered areas were clean and granulating when the patients were evacuated.

In three cases in which bacteriological examination showed organisms to be present the wounds healed by primary union. In two of the three there was a slight elevation of temperature (Figs. 14, 15); otherwise convalescence was absolutely uneventful.

THE APPLICATION OF PRIMARY EXCISION AND SUTURE IN CIVIL PRACTISE

The surgeon in civil practise has several distinct advantages over the military surgeon: he usually has sufficient time, with assistants and an equipment that will enable him to work to the best advantage; his cases come to him promptly after injury; rarely are they suffering from prolonged exposure to cold and

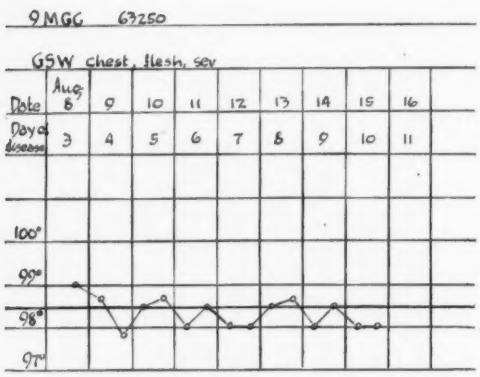

Fig. 14. Case 160. Gunshot wound of chest wall excised at the front 3½ hours after injury; four small foreign bodies removed. Fifty-nine hours later, at the base, the dressings were removed in the operating room, cultures made, and the wound which showed no macroscopical evidence of infection, was sutured. Captain Gibson reported 48 hours later: "Few colonies. No hæmolytic streptococci." Healing by primary union.

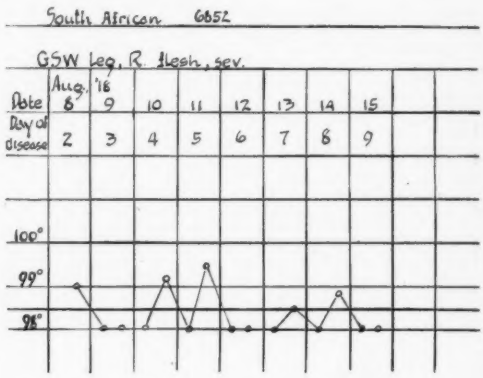

Fig. 15. Case 162. Gunshot wound of right leg, excised and "bipped" at the front, 5 hours after injury; culture made and wound sutured at the base 47 hours later. Forty-eight hours later Captain Gibson reported: "Many staphylococci; slightly hæmolytic." In spite of this the wound healed by primary union.

dampness, from extreme fatigue and hunger—important factors in the production of shock. On the other hand the wounds of civil life are frequently extensively lacerated and contused in contrast with the more sharply defined wounds caused by shrapnel and bullets, *when there is no bony injury*. When the impact of shrapnel or bullet has been transmitted to bone, causing a fracture and showering of bone fragments through the soft tissues, the resulting condition, in so far as the complete excision of damaged tissue is concerned, presents much the same difficulties as the lacerated and contused wounds of emergency and industrial surgery. In both cases the chief difficulty, aside from anatomical considerations, lies in determining the extent of injury, and in removing all the damaged structures and tissues whose blood supply has been destroyed. With crushing wounds, the surgeon will remember that the degree of injury is usually more extensive than may appear in the first few hours. The result of trauma to the blood supply appears gradually through 24 to 48 hours, so that tissues which appear fairly normal at operation may show definite evidences of gangrene 24 hours later.

To accomplish a successful result attention to certain details is of especial importance. Adequate incisions, with an exposure of the injured parts that will permit the operator to see clearly into every corner of the wound, are absolutely essential to success. If the damaged tissues are completely excised an eight-inch incision will heal as rapidly as one of four inches. If infected material is left behind a small incision will not be of avail. The use of a staining solution such as methylene blue or brilliant green, as advised by LeGrand, Wilson Hey and others, may be of help in recognizing recesses of the wound that might otherwise escape attention. Complete control of hæmorrhage and obliteration of all dead spaces without undue tension have been frequently shown to be of primary importance. Dispensing with the constrictor at the earliest possible moment will aid the operator in determining whether the tissues left behind have an adequate blood supply. The contraction of the stimulated muscles when the paralyzing effect of the constrictor has been removed will also help to show the vitality of the tissues.

In cases of doubt, the procedure of loosely packing the wound after excision with gauze saturated with 1:1000 flavine solution, or with liquid paraffine, and waiting for 48 to 72 hours before completing suture, seems to us to be of distinct value. The dressing may be removed

in the operating room with all precautions as to asepsis 48 or 72 hours after operation. If at that time there is no evidence of infection or necrosis, a culture can be made from the depth of the wound, and suture completed. If necrosis is evident in any part of the wound, the necrotic tissue can be excised and suture completed; or delayed for another 48 hours as the judgment of the operator may indicate. In doubtful cases such a course offers the advantages of primary excision, and at the same time obviates the possibility of locking up infection in the depth of the wound. If cultures of the excised wound show hæmolytic streptococci to be present, it is wiser to remove all sutures and sterilize the wound with Dakin's solution.

SUMMARY

1. Of 116 flesh wounds treated by primary excision and suture at a base hospital on an average of 49.81 hours after injury, 99 (85.3 per cent) were completely successful; 11 (9.5 per cent) were partially successful; 6 (5.2 per cent) were complete failures. Of the failures 5 were due to infection with hæmolytic streptococci.

2. Of 45 wounds complicated by a wide variety of bone, joint, nerve or tendon injuries, operated upon after a similar interval of time, 26 (57.7 per cent) were completely successful; 17 (37.7 per cent) were partially successful; 2 (5 per cent) were failures.

Of the total, 77.6 per cent were completely successful; 17.4 per cent were partially successful; 5 per cent were failures.

3. Of 37 wounds excised at the front on an average of 16.3 hours after injury, and sutured at the base 62.6 hours later, 31 (83.8 per cent) were completely successful; 3 (8.1 per cent) were partially successful; 3 (8.1 per cent) were failures. The successful cases included 9 cases complicated by bone or tendon injury.

4. By careful attention to details of technique the writer feels that similar methods may be applied in the treatment of wounds in civil practice with equal or still better results.

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SECONDARY SYPHILIS OF THE UTERUS

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THE scarcity of literature on secondary syphilis of the cervix uteri justifies the publication of the following observation.

M. H., age 26, white, is a prostitute of the clandestine variety. She has several "friends" and was arrested on the street while walking with a soldier. As the Wassermann test was found positive, she was sent to the City Hospital for treatment on November 28, 1918 (Adm. No. 11573). She claimed to be perfectly well and was highly indignant at her detention. On close interrogation she finally admitted that she had had a small sore at the external genitals three weeks ago, and that she had some burning sensation on urination. She had had one confinement seven years ago.

The general examination was negative. There were absolutely no clinical signs of syphilis upon her body; in particular, there were no mucous patches in her mouth, no enlarged glands, no cutaneous eruptions.

The gynecologic examination revealed the following: Upon the left labium minus near the clitoris was the remnant of the primary lesion— a whitish nodule beneath which the characteristic parchment-like induration was still plainly palpable. The inner aspect of both labia minora was diffusely reddened and a shallow ulceration occupied the fossa navicularis, obviously the result of an irritating vaginal discharge. Otherwise the external genitals appeared normal. The uterus lay in pronounced retroversion. There was a slight right-sided laceration of the cervix with a moderate eversion of the cervical lips.

This eversion became more marked upon introducing and spreading a bivalve speculum. When the thin grayish secretion which covered the cervix was wiped off, the lower third of the cervical canal lay open to inspection. The cervical mucosa showed, posteriorly, an oblong patch, about ¾ centimeters in its longest diameter, which lay about ½ centimeter above the external os. This patch was very slightly raised above the neighboring mucosa and had a finely granular, pinkish surface. At the circumference and extending a little into the patch was a faintly yellowish discoloration. Two other, smaller and more nearly round patches lay to the right of the larger lesion, and a fourth patch could be seen upon the mucosa anteriorly. All these patches felt soft to the touch and bled very slightly when rubbed with a cotton-armored applicator. The secretion of these patches examined with the ultra-microscope, showed an abundance of very active spirochætæ of the typical pallida variety. Slides stained according to Fontana revealed the organism in large quantities.

The patient received an injection of salvarsan and energetic inunctions together with potassium iodide internally.

On December 23, 1918, Dr. Loyd Thompson of Hot Springs, Arkansas, an authority on syphilis and author of a recent book on the subject, kindly examined the patient with me. He found a slight adenopathy of the neck and groins, the left patellar reflex a trifle increased, the pupils a little sluggish. *Otherwise there were no secondaries* present. In the speculum, the patches within the cervical canal were practically unchanged except that the color of the largest patch was now deep red. The cervical secretion, however, was lessened and was tinged with blood. The spirochæta could again be demonstrated by dark field illumination.

A second injection of salvarsan was given and the mercury rubs and potassium iodide administration continued; and on January 1, 1919, the primary lesion upon the labium minus had completely disappeared. Early in January, I was taken sick with influenza, and when I resumed my work at the hospital, I found the patient had been discharged "in good health" but, unfortunately without a final local examination, and I have been unable to trace her present whereabouts.

EPICRISIS

We have to deal in this instance with a fairly recent case of syphilis. The initial lesion in the vulva was still present but so far advanced toward resolution that the Wassermann test had had time to become positive. If we retain, for the sake of convenience, the old classification of Ricord, we have to define the case as an early stage of secondary lues. Strange to say, the classical manifestations of the disease were altogether absent; in particular, cutaneous eruptions were lacking. There were, however, several patches upon the mucosa of the cervical canal which, from their coincidence with the initial sclerosis and a positive Wassermann, were highly suggestive of syphilis. The microscopic demonstration of large numbers of the spirochæta pallida in the secretion of these patches clinched the diagnosis.

Other lesions which might have to be considered, could quickly be excluded. A diphtheritic patch would have been covered with a typical membrane. A cancerous ulcer would have bled easily; in addition, it would at this early stage have been solitary. A tuberculous ulcer would have presented a ragged appearance; and a simple erosion would have occupied the outside of the vaginal portion but not the cervical canal.

Our case, therefore, is to be classed as one of secondary syphilis of the cervix uteri. The number of recorded cases of this kind is very small. In 1916, Ehrenfest and the writer[1] collected the entire available literature on the subject and added eight personal observations. Since then no new reports have appeared in print. Secondary manifestations of syphilis upon the cervix manifest themselves in the form of macules, papules, and ulcerations. These forms probably represent three successive stages in the development of a lesion caused by scattered accumulations of the spirochæta in the squamous epithelium of the cervix. The parasite can readily be recovered from the secretion of any of the three forms, and this explains the great infectiousness of secondary lesions. Wassermann is positive in this stage. Macules and papules have no symptomatology of their own while ulcers may give rise to profuse yellowish discharge. The whitish appearance of the macules, the slight elevation of the papules and the typical yellowish color of the ulcerations render diagnosis comparatively easy. Secondaries in other parts of the body form a valuable aid. Cervical lesions as a rule, heal quickly and may disappear without leaving any traces. Specific treatment, energetically applied, brings about resolution in a very short time.

The present case differs from this general picture in several important particulars. Whereas in all previously known cases the lesion was situated upon the *outside* of the vaginal portion, this to my knowledge is the first instance where the specific affection could be demonstrated *within* the cervical canal.

[1]Gellhorn and Ehrenfest. Syphilis of the internal genital organs in the female. Am. J. Obst., 1916, lxxiii, No. 5.

There were no secondaries anywhere in the body, and as the state of the primary lesion indicated the recent date of infection the intracervical ulcerations must be regarded as the first and only secondary manifestations of syphilis in our patient.

Finally, the unusual resistance of the lesions to specific treatment deserves mention. Even after an injection of salvarsan and several weeks of mercury inunctions, the size of the lesions was unchanged and spirochætæ could still be found.

There is yet another important aspect of the case. In the paper previously referred to, Ehrenfest and the writer studied the question of the infectiousness of the physiologic secretions of syphilitic women. We referred to an observation made by Mueller where a prostitute was suspected of infecting men with syphilis and was examined repeatedly but presented no luetic symptoms or lesions. Later, Wassermann was found positive and the spirochæta was demonstrated in her menstrual and leucorrhœal discharges. Graefenberg, too, found, in four cases, living spirochætæ in the secretion from the cervix. Two of his patients were pregnant; all four had condylomata lata on the vulva but no lesion upon the cervix. In 5 other women who had received specific treatment, the spirochætæ could not be found in the cervical secretions. Ehrenfest and the writer, finally, examined the cervical discharges in a large number of women and found the typical spirochæta in 2 cases though in both the cervical secretions were quite clear and apparently normal. One of these patients had, some months previously, secondary lesions upon the cervix which healed under energetic treatment. We, therefore, felt justified in the conclusions that the normal secretions of syphilitic women may cause infection even in the absence of local specific manifestations.

In the light of the present observation, however, this conclusion may have to be modified. In our case the fortunate coincidence of a cervical tear permitted me to inspect the *inside* of the cervical canal and to find there the specific lesions with its rich supply of spirochætæ. It is permissible to

assume that in the cases mentioned above, such lesions existed within the cervical canal but were invisible through the closed external os. Until further evidence to the contrary is obtained, it will be safe to adhere to the old view that discharges contain infectious spirochætæ only in presence of a local lesion.

SUMMARY

In a syphilitic woman with a very recent infection, several ulcerated patches *within* the cervical canal constituted the first and only manifestations of secondary syphilis. The discovery of these lesions was made possible by an eversion of the cervical lips due to an old tear. A large number of the spirochætæ pallidæ could be demonstrated in the secretion of the patches. Secondary lesions of the cervix are quite rare. They have been found upon the outside of the vaginal portion, and this is the first case on record where the lesion was located within the cervical canal.

THE IMPORTANCE OF EARLY RECOGNITION OF SURGICAL CONDITIONS OF THE BILIARY PASSAGES

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EVERY surgeon, through intensive study of living pathology, endeavors to educate the profession to realize the importance of early intervention in the diseases of abdominal viscera which experience has shown cannot be benefited except by surgery. The ill effects of delay are unlimited. It is a matter of justice to both patient and surgeon that the internist advise early operation in conditions that fail to respond to treatment within a certain reasonable time. As a matter of fact there are a number of conditions which, as soon as the diagnosis is made, demand surgery. Experience has proved this in cases without number. And if this be true for the disease itself, how much more important is it for the complications which may arise as a result of the original condition.

There are few abdominal conditions which carry within themselves more potential mischief than diseases of the gall-bladder and biliary tract. We believe the surgeon has a right to expect, if not to demand, the privilege of consultation in all suspected gall-bladder cases before the patient's condition has become grave, and before those complications set in which increase the difficulties of operation, and threaten the life of the patient. It is essential not only to diagnose such conditions, but to recognize them early, and to realize when medical treatment is futile.

The diagnosis of affections of the gall-bladder is not always easy. Acute cholecystitis, for example, generally presents reflex symptoms as part of the clinical picture. Even at the operating table the less astute, or the inexperienced surgeon, is not always able to recognize the presence of cholecystic disease. The normal blue appearance of the thin-walled gall-bladder may not be changed, but serious infection may be in its contents and only awaiting a chance to invade the gall-bladder wall.

Although clinically the picture of acute cholecystitis and its complications presents many variations, there are a few common features which characterize the disorder. Physical examination together with a careful history should, in the majority of instances, make the diagnosis clear. Lightness of touch on the part of the examiner is essential to obtaining all the information that can be elicited by palpation. Examination for rigidity and tenderness should include both sides of the abdomen, the left side first. In doubtful cases, placing the tips of the index and middle fingers of the right hand gently over the gall-bladder region while the patient takes a deep breath, will often elicit tender-

ness that cannot be recognized otherwise. Further, pressure often gives valuable information when the patient inhales deeply and holds the breath. Tenderness in this region, however, does not always result from the gall-bladder alone. A high appendix, an active duodenal ulcer, torsion of the omentum, circumscribed hæmorrhage into the head of the pancreas, and other conditions, will give signs that cannot always be differentiated. A clean-cut history may help, but even then errors creep in.

More than a decade ago Moynihan called attention to what may be regarded as premonitory symptoms of gall-bladder disease. He laid especial stress on the fact that the earliest symptoms are referred, not to the liver or gall-bladder, but to the stomach. The symptoms are a feeling of epigastric fullness, weight or distress after eating, relieved by belching and especially by vomiting. There is a distinct relationship to certain kinds of food. If no relief is obtained, there results an increasing sense of tightness, and finally acute pain, which may be eased by loosening the garments or by bending the body forward. Heartburn and acid eructations also frequently form part of the history. During this postprandial discomfort, the patient often notices a catch or pain in the right costal margin on taking a deep breath. Chilliness is also often a complaint. These attacks occur with more or less frequency, increase in severity, and the pain usually radiates to the back, the right shoulder or the right arm. Vomiting of bile is common. Jaundice is generally not present during the attack, but may or may not appear two or three days afterward. A light icterus at this time usually indicates that a small stone has successfully passed through the cystic duct and caused only a transitory stasis of bile as it traversed the papilla of Vater. It may, however, also indicate that the inflammatory process has extended into the common or hepatic ducts, and that obstruction is due to swelling of these passages. Operation is especially indicated in this class of cases. Sooner or later a stone will fail to pass, will lodge in the common duct, and lead to acute or chronic obstruction of that canal.

No one will deny that acute cholecystitis with common duct obstruction is much more serious than uncomplicated cholecystitis. Operation with this complication added, is not only more difficult, but also, more dangerous. Furthermore there is the danger to the head of the pancreas to be considered. In the acute form this may lead to fat necrosis; in the chronic form to fibrosis, and ultimately, perhaps, to pancreatic diabetes. These serious complications can only be forestalled by early treatment of the cholecystic disease. The operative mortality rises directly with the gravity of the superadded conditions. In acute cholecystitis the figure ranges from 2 per cent to 4 per cent; when complicated with common duct obstruction, it rises to 5 per cent; and with pancreatic involvement, it reaches 9 per cent. While on the subject of the pancreas, it might be emphasized that cholecystitis is the most common cause of pancreatic lymphangitis. Pancreatic lymphangitis is the first stage of chronic pancreatitis. Not only is chronic pancreatitis, in many cases, directly attributable to cholecystitis, but a large percentage of cases of acute pancreatitis is due to this condition. Indeed, we might go farther, and say that carcinoma of the head of the pancreas may have cholecystitis as an underlying cause in some instances. Small, isolated carcinomatous nodules are met with in the head of the pancreas, which in some instances are consequent upon a circumscribed hæmorrhage or focus of infection which undergoes organization. Finally, carcinomatous transformation takes place in the remaining epithelium. Such a case came under our observation but a short time ago, in a young woman, 20 years of age.

She had complained of digestive disturbances for a year, and attacks of pain, well localized to the right hypochondrium. For several weeks before admission, she had noticed a light icterus, which gradually deepened until on admission, it was fairly well marked. At operation, the gall-bladder was opaque, grayish, with slightly thickened walls. A hard mass, as large as an English walnut, was discovered in the head of her pancreas. It was dark brown and sharply outlined except in one place. It was excised and the gall-bladder was also removed. Pathologically, the gall-bladder was of the ordinary type of "chronic interstitial cholecystitis," with slight superficial ulceration of the mucosa, but

definite fibrosis and lymphocytic infiltration of its walls. The mass from the pancreas showed scar tissue, pigmented with hemosiderin, with a sort of capsule nearly encircling it. Remnants of pancreatic structure were imbedded in the scar tissue. At one point there was a fragment of normal pancreatic tissue and into this were streaming epithelial cells in atypical clumps and chains, very definitely invasive, and hence carcinomatous.

Pancreatic cysts may also be due directly or indirectly to spread of infection from cholecystic disease.

These are only some of the possibilities which should be taken into consideration when counseling delay in operation for gall-bladder disease. To the surgeon, these show either in acute or chronic gall-bladder disease, that an operation upon the biliary passages is not complete until the pancreas is thoroughly examined.

Surgeons do not often have the opportunity of meeting gall-bladder cases in which the pathological change is a simple one. If the bacterial infection has been of low virulence, and the resistance of the patient is good, the attack may subside, and both practitioner and patient are deceived into false reliance on the "appearance of rectitude." Surgeons see acute exacerbations or acute inflammations implanted on a chronic process. These acute inflammations have been compared to those which occur in the appendix, but they usually show much more of a phlegmonous character. The extent of the destructive process seen at operation is proof convincing that early surgery is the rational treatment for acute cholecystitis. Among these destructive processes and complications are gangrene with general sepsis, perforations with local or generalized peritonitis, and varying degrees of cholangitis. These are fortunately not the more common conditions, but they occur sufficiently frequent unfavorably to influence the prognosis in many cases.

From the standpoint of gross and microscopic pathology, we have met in the last 1000 cases, 20 gangrenous gall-baldders. Twenty-six have shown acute lesions only. The remaining 130 acute cases have had chronic lesions as well. We recognize in the acute variety, a simple inflammation involving particularly the mucosa. The submucosa takes part to a less extent, and the other coats show minor lesions. The changes in the mucosa amount to a cloudy swelling and mucoid degeneration of the epithelium, with occasional desquamation. In the other coats there is a varying amount of œdema, moderate active congestion, and perhaps slight cellular exudation of polymorphonuclear leucocytes, a few eosinophiles and lymphocytes. In our experience, this condition was seen only seldom. Most gall-bladders, when acute, have shown far more extensive lesions. There have been varying degrees of the following changes: in the mucosa, ulceration; in the other coats, œdema and diffuse polymorphonuclear infiltration. Our name for these is "acute diffuse suppurative cholecystitis," and we add, as occasion demands "with abscess formation," or "with abscess formation and gangrene." Unfortunately enough, these latter diagnoses had to be made very frequently.

To repeat what has so often been contended, a gall-bladder once diseased, never returns to its normal condition. If the patient recovers from the primary acute cholecystitis through non-surgical treatment, lingering low-grade infection, with perhaps insufficient biliary drainage will lead to a chronic cholecystitis. Occasionally other conditions result, such as empyema, or hydrops.

Pathologically, in both calculus and non-calculus chronic cholecystitis, our experience has shown that in an overwhelming majority of cases, all the coats of the gall-bladder are involved. In the mucosa, there is congestion, swelling, desquamation and increase in the amount of mucus. Lipoid changes occur in which lipoids and cholesterin are deposited in the mucosa and the submucosa. These deposits give a speckled yellow appearance grossly, and the name "strawberry gall-bladder" has been applied. This material comes from disintegration of cells, and it is seen quite commonly. Very often small crystalline masses of cholesterol or lipoids are surrounded by foreign body giant cells. We do not attach any very special significance to strawberry gall-bladders. The same condition may occur in other gall-bladders and

chance may prevent deposition in this particular way. Ulceration, superficial, sometimes deep, is very frequent. The ordinary chronic inflammatory changes, namely, fibrosis and lymphocytic infiltration, are present in varying degree. These changes involve submucosa, muscularis, and peritoneum. We hold that these interstitial changes are more important than changes in the mucosa. They show how infection spreads from the interior of the gall-bladder to the peritoneum. They explain the adhesions which surround the organ, and envelop and involve neighboring viscera. Dense peritoneal sheets often cover the pylorus, the duodenum, the hepatic flexure of the colon, great omentum, or even the tip of the appendix. The normal regional anatomy is often completely obscured. It is often impossible to separate this vicious conglomerate mass with ordinary surgical instruments, and we are either forced to run the risk of the severe trauma that would result from separating the mass, or let it remain and do what we can in some other way to alleviate the sufferings of the patient.

In long standing cases the gall-bladder is often atrophic; in others it may be distended and filled with thick mucus, sometimes bile stained, and sometimes, when the normal function of the organ has long been lost, no trace of bile is present. Gall-stones were present in about 70 per cent of cases. Their presence adds insult to the already existing bacterial injury. Hyperplastic and proliferative changes occur, and there are types in which the epithelium shows changes which might be regarded as precancerous. Actual primary carcinoma has occurred in 7 of our cases, and gall-stones were present in 5 of these.

The clinical symptoms of chronic cholecystitis may be very varied. Such things as the pressure and pull of adhesions on surrounding viscera, the mechanical action of gall-stones in causing the bladder to elongate with subsequent tension and traction on sensory nerves, all serve to complicate the history. There are presented features of gastric and intestinal disturbances, pylorospasm, and spastic constipation. The severity of the special attacks which are referable directly to the gall-bladder often decreases as the condition becomes more chronic. This is very apt to be considered a sign of improvement. Quite the contrary. The gall-bladder gradually loses its power of contraction owing to induration of its walls, and adhesions cause symptoms referable to other viscera to come into the foreground. When acute exacerbations occur, and when gall-stones migrate to the common duct, attacks, more or less typical occur. Colic-like localized pain, vomiting, fever, jaundice, local resistance and tenderness are then the predominant symptoms.

Medical treatment of the disorder can, and often does, effect a certain degree of improvement, and relief of symptoms, It cannot bring about a cure; it cannot reach the actual site of the trouble. Neither drugs, nor the waters of so-called "cures," Carlsbad or others, can remove the stones, nor can they bring the gall-bladder back to normal. These "cures," so far as they regulate the life of the patient and provide for free elimination of toxic material, are of temporary value in bringing about a period of latency. But the quiescent and latent gall-bladder is not to be trusted! Sooner or later the consequences of lingering infection will make their appearance, an acute exacerbation will occur; and the patient will be just that much worse off than before. The immediate risks of chronic cholecystitis are much the same as those already mentioned in connection with the acute variety. Unfortunately we have no horoscope at our command to enable us to foretell which cases will, and which will not, develop complications, such as perforation, peritonitis, obstruction of the common or cystic ducts, induration of the head of the pancreas, with its train of possibilities, carcinoma of the gall-bladder, and so on.

From a study of selected specimens, it is possible to reconstruct a more or less complete picture of what occurs in advancing disease of the gall-bladder. The first changes are referable to the mucosa and consist of cloudy swelling and mucoid degeneration. Fatty degeneration and lipoid changes then make their appearance. Coincidentally, there is congestion, œdema and cellular infiltration of the walls. Desquamation occurs, and then

ulceration. If the infection is more virulent, the entire mucosa is destroyed and the walls are thickened with a dense pus-cell infiltration, a large amount of œdema, and quantities of fibrin. Petechial hæmorrhages occur. A further stage will show the pus cells gathered together in larger or smaller abscesses, and finally gangrene will make its appearance. These specimens are often perforated. The peritoneum is covered with thick plastic exudate. If the infection is overcome before gangrene has occurred, very rarely if it is present, organization tissue makes its appearance, grows older, contracts and thickens the walls, leaving them less elastic, opaque, and much less resistant to subsequent reinfection. The mucosa is replaced more or less completely. Infection, however, usually lingers, and does not completely disappear. In addition small masses of mucus, desquamated cells, and bacteria will have formed a nidus for the formation of gall-stones. Their irritation, plus the irritation of the low grade infection, induces more mucoid changes, more desaquamation, and thus a vicious circle is completed. The irritation leads to an ever increasing, slow fibrosis. The epithelium may become hyperplastic, and small villous-like projections will appear, covered by a more or less degenerated epithelium. As the gall-stones increase in number and size, their irritative effects are multiplied. Deep scarred ulcerations and ridges appear in the positions on which they press on the gall-bladder. Connective tissue grows around them until they may lie in a definite pocket. If a stone becomes impacted in the cystic duct, or in the neck of the gall-bladder, the accumulation of débris will cause a distention of the viscus, with thinning of its walls, destruction of the mucosa, and flattening of the scarred tissue. The muscularis disappears almost entirely, and a large palpable tumor may be recognized clinically. The changes in the epithelium, which are sometimes papilloma-like, have led to classifications such as "papillomatous cholecystitis." While we are not in sympathy with such detailed classifications which only tend to confuse and render comparisons and statistics difficult, we do recognize that conditions covered by that term may have sinister possibilities. Carcinoma can and does arise from epithelium which has been subjected to long-continued irritation, and this possibility in connection with the gall-bladder is ever present. Under some circumstances, when the inflammatory process continues sufficiently long, the gall-bladder may gradually shrink, with contraction of the scar tissue until it becomes nothing but a small fibrous sac, deeply embedded in adhesions and filled with closely packed gall-stones. At any time an acute exacerbation may occur, and then the process outlined in the description of the acute form will be engrafted on the chronic one.

Early operation in chronic cholecystitis is comparatively simple. The end-results are 95 per cent satisfactory, as far as complete cure is concerned. But when the bile passages are involved, we are confronted with a procedure which ranks high among technically difficult operations, and the end-results are less satisfactory. When the pancreas is involved, the outlook for permanent relief is much obscured; the hopelessness of carcinoma of the bile passages needs nothing more than to be mentioned.

The importance of early recognition of surgical conditions of the bile passages is obvious. The history, together with careful physical examination are the most reliable guides to a diagnosis. Laboratory procedures, and X-ray findings, when properly interpreted, are valuable adjuncts. When the diagnosis is made, the treatment is surgical. The complications and sequelæ, which have been presented in brief outline, are too constant and too grave to allow any other but this procedure.

A CONTRIBUTION TO THE STUDY OF "STIFF AND PAINFUL SHOULDER"

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THE classification of the pathologic lesions causing the condition which may perhaps best be defined as stiff and painful shoulder appears as yet incomplete. Experience has shown that many different lesions cause the symptom-complex included in the above term. These have been carefully studied and minutely described by various observers. There remain a certain number of cases which do not seem to fit into the classification thus far made. The pathologic lesions appear to be of a different type and they do not yield to the therapeutic measures advocated for the various types of injury. It would appear, therefore, that there are etiologic and pathologic factors which do not comply with those thus far described that will give rise to stiff and painful shoulder. It will be the object of this paper to suggest that a tear of the tendons of the latissimus dorsi and teres major muscles may play an important rôle in the etiology of some of the cases of stiff and painful shoulder and also to point out certain therapeutic indications in the disability caused by this lesion.

Because of the frequency of stiff and painful shoulder after comparatively mild trauma and its resistance to ordinary therapeutic measures, the subject has been one which has aroused considerable interest for many years. It was at first classed as a brachial neuritis or a circumflex palsy. These conditions do occur but as a rule the causative trauma is more severe and the symptoms are so much more definite than those of the ordinary type of the disability that careful examination for true nerve lesions will reveal their presence and thus serve to differentiate the two conditions. The same is true in the differentiation of the more severe injuries of the shoulder such as fractures of the greater tuberosity of the humerus, fracture of the clavicle or of the scapula. In these the diagnostic signs are definite and resort to the X-ray will establish the diagnosis.

The masterly paper of Codman, discussing the subject of stiff and painful shoulder, directed the attention of surgeons to the frequency and importance of the condition and the necessity for its careful study. He called attention to inflammation following trauma of the subacromial or better called subdeltoid bursa as a causative factor in stiff and painful shoulder, and in a later publication to the frequent occurrence of a small tear in the tendon of the supraspinatus muscle accompanying the inflammation of the bursa. Brickner has contributed largely to the subject and thrown valuable light on many obscure points. Other observers have studied various points in pathology, diagnosis and treatment. For a more or less complete review of the literature of the subject the reader is referred to the bibliography accompanying this paper.

SYMPTOMS

Stiff and painful shoulder presents a more or less classical picture. After a moderate trauma of a rather definite type, usually a fall in which the patient puts out his arm to save himself, or a wrench of the shoulder caused by a sudden motion while the arm is abducted as while hanging on a strap in a street car, or a sudden muscular effort as pitching a base ball before the muscles are accustomed to the required motion, after such a trauma the patient feels a snap in the shoulder, followed by a severe sharp pain and in some cases the arm falls almost helpless by the side. Motion of the arm is extremely painful especially the movement of abduction and that of external rotation when this is carried out with the arm in a position of moderate abduction. Because of the pain the arm is carried in the sling position and a moderate amount of atrophy of the deltoid muscle supervenes in a rather short time giving the appearance of a nerve involvement. The pain is present constantly in some cases

and extends from the shoulder down the inner and outer sides of the arm to the elbow and in more severe cases even to the wrist and hand. Pain is accentuated by motion and more by active than passive motion. There is, however, as Codman has shown, a small range of motion amounting to about 10 degrees which is not painful. This is due to the fact that within this range the injured muscles are not placed on the stretch and consequently are not further traumatized. This symptom serves as a point of differentiation between extra-articular and intra-articular lesions of the shoulder for in the latter, where joint surfaces are involved, pain occurs at the very beginning of joint movement. The condition easily becomes chronic and tends to recur after minor traumata.

Examination of the shoulder seems at first sight to reveal very little of a definite nature. There is as a rule some tenderness beneath the tip of the acromion process, the patient showing an extreme disinclination to move the arm. There is a resistance to passive motion beyond an arc of 10 to 15 degrees. According to the length of time the disability has existed there is a certain amount of atrophy of the deltoid muscle and as time goes on the atrophy becomes more marked than an atrophy that can be attributed to disuse alone. In the cases of the type under discussion in this paper there is a point of tenderness on the inner surface of the humerus high up in the axilla. This sign has been noted by Brickner and he speaks of the difficulty of assigning a definite cause for it.

These symptoms may be taken as typical of a stiff and painful shoulder. Except for the atrophy of the deltoid which does not come on at once and the presence of a tender spot in the axilla, there appear to be no points of diagnostic difference between the form under discussion and that due to many other forms of lesion. It is necessary, therefore, to consider the other forms of lesion and these being discarded, seek further for a causative factor. The main forms of disability of the shoulder may be classified as follows:

1. Brachial neuritis.
2. Intra-articular lesions, including luxations.
3. Fractures:
   a. Of the humerus, including the greater tuberosity;
   b. Of the scapula, including the acromion process and small splits of the glenoid rim or separation of the glenoid ligament;
   c. Of the outer part of the clavicle.
4. Lesions of the head of the humerus (tuberculosis, syphilis, neoplasm).
5. Spontaneously reduced dislocations.
6. Bursitis, coracobrachial or subdeltoid.
7. Injury to the supraspinatus tendon.
8. Lesser tear of the capsule of the joint by sprain.

After the above conditions have been ruled out by careful examination, there remain a number of cases which do not fit in to any of the diagnoses suggested. These cases present the symptoms as outlined above and resemble closely cases of subdeltoid bursitis. They present a point of marked tenderness on the inner surface of the humerus high up in the axilla and in cases of moderate standing a more marked atrophy of the deltoid than can be explained by disuse alone.

MECHANISM OF CAUSATION OF THE TEAR

In cases of stiff and painful shoulder from this cause one is struck by the remarkable similarity of the trauma in many cases. The patient states that he grasped a flying ring in a gymnasium or was hanging to a strap in a car and the car gave a sudden lurch, or he felt he was about to fall and threw down his arm to save himself, or was pitching a baseball and felt something give in his shoulder. In all cases the predominant factor is a sudden sharp adduction of the humerus either in the form of a reflex contraction stopping unexpected abduction or a suddenly applied muscular overstrain as in pitching an incurve or a high straight ball which brings into play sudden snappy adduction together with internal rotation. In all these motions the muscles thrown into sudden action are the teres major and latissimus dorsi which contract with great violence in order to prevent the sudden and unexpected abduction. When we consider in addition that in any muscular action, the primary contraction

occurs first and most forcibly in the antagonistic group of muscles we see that in the motion of abduction the teres major and latissimus dorsi are already contracted as a result of this law. Now add a very sudden overstrain to prevent further abduction and a double force is suddenly placed on the muscle and tendon fiber. Further in a sudden motion the muscular contraction is less controlled than in one that is slow and well co-ordinated and instances of tear of tendon or muscle fiber or even fracture of bone from suddenly applied muscular force are not infrequent. In the shoulder Codman has called attention to the frequency and importance of tear of the supraspinatus tendon due to muscular violence suddenly applied, and attributes to it the main cause of the disability in many cases of injury to the shoulder. His findings have been substantiated by many other observers. There is a great similarity in the form of the tendon of the supraspinatus and that of the tendons of the latissimus dorsi and teres major. All are thin, flat, and spread out over the bone at their insertions and are tendons of powerful muscles. Also they are bound to the bone or to one another (in the case of the latissimus dorsi and teres major) by thin connective tissue which beneath the tendon is closely attached to the periosteum. The sudden application of muscular force to tendons of this character will result in a tear of the tendon fibers close to the point of insertion and a tear of the small connective tissue and periosteal fibers which hold the tendons flat against the bone.

PATHOLOGY

There occurs as a result of the tear of the tendon a small hæmorrhage at the site of injury and later an exudation of serum with the usual œdema and later phenomena of the process of repair. This extravasation in the tendon and beneath the periosteum places the latter on the stretch and makes it tender on pressure and on movement of the arm. If allowed to run its own course, the lesion heals, provided motion is interdicted, and the final result is a firm non-vascular scar which gives rise to pain with every movement of abduction. If motion is persisted in during the attempt at repair every attempt at abduction of the arm is accompanied by severe pain due to tearing of the reparative tissue. As a result repair is very slow, and when it does occur is insecure.

The extravasation and œdema passing into the tissues of the axillary space is directed by the arrangements of the fascial planes into the quadrilateral space between the inner surface of the humerus, upper border of the tendon of the teres major, outer border of the long head of the triceps, and lower border of the subscapularis. There it encounters and presses on the main trunk of the circumflex nerve as it passes backward through this space and winds around the humerus to supply the deltoid muscle and the skin over the shoulder. This nerve is involved secondarily in the inflammatory process and thus the symptoms of pain over the point of the shoulder on motion and a greater amount of atrophy than can be attributed to disuse ensue as the result of the partial disabling of the function of the nerve. In more severe cases with a greater amount of effusion, the musculospiral nerve which lies in close apposition to the circumflex is involved and gives rise to pain along the course of the internal and external sensory branches which supply sensation to the sides of the arm as far as the elbow.

The condition is apt to recur after slight trauma for the following reason, especially in a neglected case. Healing results in a weakened scar poorly supplied with blood which has formed under constant irritation applied by the movements of the arm. Any trauma will therefore cause a tear at the site of the scar. In more severe cases in which the patient has held the arm in the sling position the scar tissue may involve the circumflex nerve and give rise to permanent impairment of its function. The scar may also be such as to cause permanent shortening and disability of the muscle.

The condition, as outlined above, is similar to well known occurrences in other joints, such as sprained ankle, with the addition of a few special factors governed by the anatomical relations of the structures involved.

Robert Jones has so well summarized the general principles of strains of muscular attachments around joints that quotation at length is here given:

Strains of muscular attachments about joints often give rise to serious impairment of function. From incomplete diagnosis these conditions are often inefficiently treated. They are diagnosed by the fact that there are certain movements that the patient cannot perform because he is suddenly pulled up by pain, which he localizes fairly exactly at some point about a joint. Careful testing of the movement which hurts will generally prove that active contraction against resistance, or passive stretching of a certain group of muscles causes the pain. Further careful palpation will find a tender spot just at the attachment of a tendon, over an area no bigger than a six-pence, and a little swelling with a suggestion of œdema or fluid may be felt deep down on the surface of the bone. This tender spot is the key to the situation. It is a small patch of effusion below the periosteum or in the fibers of the tendon which run in and through the periosteum to the bone, constituting the origin or insertion of the muscle.

The pain is due to tension on this effusion caused by tension on the muscle or by direct pressure on the œdematous spot.

Such an injury may be acute in type, arising from a single sudden wrench, stretching, tearing, or otherwise loosening the strong fibrotendinous plexus; it may be subacute, arising from repeated smaller injuries, as in the familiar "tennis" and "golf" elbows; or either of these may pass on to a chronic stage, never entirely dormant, and liable to become acute on any provocation, and this chronic stage may continue for weeks, disabling the patient from taking part in active pursuits. The reason why this trifling injury is often so long continued and troublesome is that every time tension is put on the muscle a fresh assault is inflicted on the injured tissues, and this repeated injury maintains the effusion and prevents repair of the stretched or torn fibrils.

Three types of stiff and painful shoulder due to a tear in the tendons of the teres major and latissimus dorsi tendons can be recognized which depend upon the length of time the condition is discovered after the injury: the acute type, the subacute, and the chronic. The etiologic factor in all is a suddenly applied trauma. Immediately after the trauma, during the stage of exudation, the acute type presents the symptoms given above. During the process of repair and before the formation of firm scar tissue we have the subacute type which presents the great liability to relapse after slight trauma, and after the formation of a firm scar with the concomitant adhesions we have the third or chronic type with the almost useless arm.

DIAGNOSIS

Careful examination of an injured shoulder is essential for a correct diagnosis. Accurate tests of motion should be made to establish the muscles which are placed upon the stretch when pain is caused by motion both active and passive. It will be found that in many cases of stiff and painful shoulder abduction is accompanied by exquisite pain and this will be increased by external rotation of the arm carried on while the arm is in the abducted position. Points of tenderness should be looked for. A point of tenderness on the inner surface of the humerus high up in the axilla will be found in the type of lesion under consideration. Further examination of this tenderness, made by placing the thumb on the anterior surface of the teres major tendon near its insertion in the bone and the fingers behind the tendon will show that the point of tenderness can, in many cases, be localized in a small, definitely circumscribed area of the tendon which is usually found just at the point where the tendon is inserted into the bone.

Careful examination should be made to exclude other forms of joint disability. In all cases it is well to have a roentgenogram of the joint and surrounding bony structures, and wherever facilities permit a stereoscopic roentgenogram will be found of more value than a view in one or two planes.

In the subacute and chronic types, an atrophy of the deltoid muscle greater than that caused by disuse alone, and yet in which no gross lesion of the circumflex nerve can be demonstrated will point to an interference with the function of the nerve by inflammatory products following a tear of the tendon fibers.

The three significant signs which point to a disability due to a tear of the fibers of the teres major and latissimus dorsi tendons, other conditions being ruled out by careful examination, are:

1. Pain when the involved muscles are placed on the stretch by the motion of abduc-

tion and external rotation in the abducted position.

2. A definite point of tenderness in the tendons of the muscles at or near their attachment to the bone.

3. In the subacute or chronic cases atrophy of the deltoid muscle greater than that from disuse occurring without demonstrable gross nerve lesion.

TREATMENT

This may be divided into three types according to the stage of the condition when first seen, whether acute, subacute, or chronic.

In the acute stage which is encountered immediately after the receipt of the injury and the onset of the symptoms, the shoulder will do better with rest in such a position that the torn edges of the tendon will remain in apposition. This will be the sling position. Active motion may be begun the day following injury in definite periods of 15 minutes each, carried out 3 or 4 times a day. Active motion should always be kept within the limits of pain. Splinting the muscle as recommended by Jones cannot be carried out in this condition because of the anatomical arrangement of the muscles injured, but splinting the deltoid by an adhesive plaster strap placed tightly across the muscle at right angles to the direction of its fibers just above its insertion into the humerus will inhibit abduction and so lessen the danger of stretching or tearing the involved tendons.

As the object of treatment is to accomplish early absorption of the extravasation and subsequently bring about the formation of a scar with a good blood supply, massage will be found of great value. The massage in acute cases should be gentle and in the main directed to the injured part. General massage of the surrounding muscles may be used to advantage to keep up their tone during the period of inactivity and to guard against the development of local myositis which is apt to occur in muscles which have been subjected to trauma and then are allowed to remain inactive. Massage should be used daily, is best performed by the surgeon himself or by a trained masseur, should always be gentle and kept within the limits of pain.

In the acute stage then, the treatment consists in immobilization for a short time; active motion begun early for short periods and always within the limits of pain; prevention of new insults to injured or reparative structures by splinting the deltoid and inhibiting motion tending to cause such insult (for any motion which does not cause pain may be freely used and will serve to keep up muscle tone); and local and general massage intelligently employed.

In the subacute stage the treatment is essentially the same as in the acute except for the immobilization. In this stage the patient is best encouraged to use the shoulder as much as possible but always within the limits of pain. A little time taken in the examination of this type of shoulder will discover movements which can be performed without pain. These motions should be pointed out to the patient and he should be encouraged to practice such movements faithfully. Massage should be used and may be more vigorously applied as the object in this stage is to promote a new blood supply in scar tissue which is at least partly formed—a more difficult process than where the reparative tissue is forming as in the acute condition.

In the chronic and more severe cases it is necessary first to break up the firm scar and fibrous tissue which has formed in the tendons and the adhesions which have formed in the surrounding axillary tissues; also to overcome the shortening of the muscles which has taken place as the result of carrying the arm in the sling position for a considerable length of time. This is best accomplished, as recommended by Codman, by breaking up the adhesions under an anæsthetic. This transforms the condition to one comparable to a case in the acute stage and it should be treated accordingly.

SUMMARY

1. Stiff and painful shoulder of a certain type falls into the general class of muscular strain about joints, and this muscular strain centers itself in the tendons of the teres major and latissimus dorsi muscles.

2. The condition manifests itself in (a) pain, produced by stretching the injured

muscles; (b) a distinct localized point of tenderness over the site of injury in the tendon and at its attachment to the bone; and (c) early development of a moderate amount of atrophy of the deltoid muscle due to the involvement of the circumflex nerve in the inflammatory and reparative processes.

3. The condition is amenable to treatment along lines which have proved successful in similar conditions in other parts of the body. This treatment is conservative and is directed toward (a) prevention of trauma, (b) hastening of resolution of œdema and exudative processes, and (c) the formation of a pliable point of union by means of well vascularized connective tissue.

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ON THE PRESENCE OF ADRENAL RESTS IN THE WALLS OF HERNIAL SACS

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DURING the last four and a half years almost 700 radical cures for hernia have been performed by me at the Royal Hospital for Sick Children. In six of these cases small nodules, previously noticed on several occasions, have been submitted to microscopic examination; in one case a typical nodule was lost. In one child a nodule was found on each sac of a bilateral inguinal hernia. Since attention has been drawn to these little particles they are being observed with increasing frequency; the proportion up to the present works out at 1 per cent.

These nodules are minute; not being larger than 1/8 inch in diameter; practically all have been of the same size. They are embedded in the wall of the sac near, but not attached to, the cord. They appear as brownish-yellow, flattened spherical particles, having a pearly appearance. They require to be differentiated from fat lobules which they superficially resemble. So far only one nodule has been detected on each sac. Once the nodule was found loose inside the sac but doubtless it had become displaced there as the sac had been widely opened during its isolation. These fragments are also readily detached from the sacs. The sacs on which these rests have been found have been with one exception typically so-called acquired ones; the exception being a congenital hernia, i.e., one where the tunica vaginalis and the sac were common. A specimen has not yet been found in the corresponding hernial sac of the female; but only about 40 cases of the 700 were in this sex. This point is interesting as accessory adrenal tumors are commoner in the female. I have not yet observed an example of adrenal rest in an adult hernia but the cases operated upon have not been so numerous. The microscopic appearances are well shown in the accompanying photomicrographs, which have been kindly prepared for me by Dr. Haswell Wilson, pathologist to the hospital.

The interest in this observation, besides the embryological one, lies in the support which it gives to the saccular theory of hernia. In an article I published in SURGERY, GYNECOLOGY & OBSTETRICS, January, 1910, on the saccular

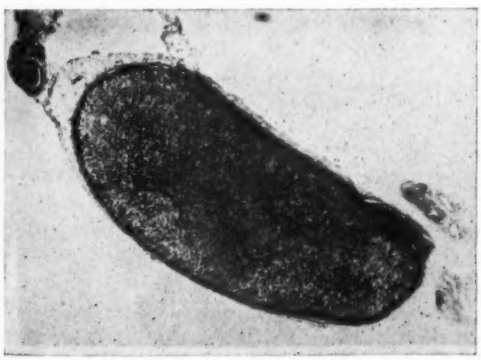

Fig. 1. Photomicrograph (x30) of section of typical nodule embedded in hernial sac.

Fig. 2. Photomicrograph (x80) of section of typical nodule.

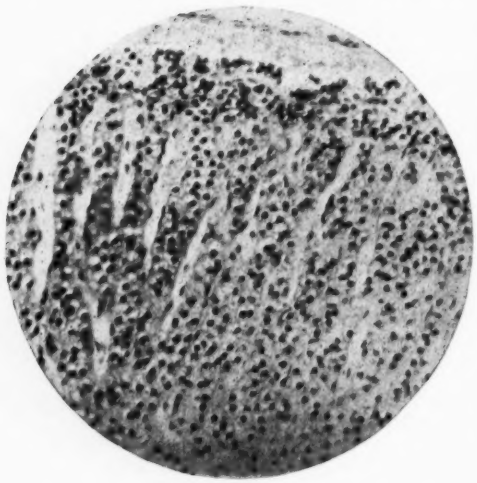

Fig. 3. Photomicrograph (x200) of section of typical adrenal nodule embedded in a hernial sac.

theory, the rare type of encysted hernia was shown to be congenital and if the saccular theory still requires further support it receives it from this fresh observation. Adrenal rests are recognized as being sometimes found lying along the cord or in association with the testicle, but their presence attached to a hernial sac claimed to be acquired negatives such a supposition.

The fate of these nodules is uncertain, probably they atrophy; they do not evidently give rise to tumors later on. The removal of this supplementary adrenal tissue has not been detrimental to the children. Since writing this note another instance of an adrenal rest has occurred. This time the little mass was surrounded by fatty masses which had they been larger would have constituted the well known lipomata of the cord; the nodule was less closely attached to the sac. The microscopic finding was the same as in the others.

DIVERTICULA OF THE POSTERIOR URETHRA

By H. C. BUMPUS, M.D., Rochester, Minnesota
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THE repeated finding of diverticula of the posterior urethra during routine cystoscopic examination led to a search through our records and the literature for similar cases. As was expected, few were found.

The literature, as reviewed by Ehrlich, revealed but 70 cases of urethral diverticula up to 1908. Watts reported one case and reviewed the literature in 1906, and Englander added two cases in 1917. In our cases the diverticula were all confined to the posterior urethra; their clinical histories vary considerably from those reported in the literature.

Watts, besides his complete and thorough review of the literature, gave an excellent classification of urethral diverticula which we have adopted:

A. Congenital diverticula

B. Acquired diverticula
   1. From dilatation of urethra due to
      a. Calculus
      b. Stricture
   2. With perforation of urethra resulting from:
      a. Injuries to the urethra
      b. Rupture of abscesses into the urethra
      c. Rupture of cysts into the urethra.

A differentiation is also made between true and false diverticula. The former is a dilatation of the normal urethra with a mucous membrane lining identical with that part of the urethra from which it arises. The latter is the result of urethral rupture and, therefore, has a lining of epithelium or fibrous tissue according to the extent of repair that has occurred. Of the true diverticula the congenital offers the most perfect type. It occurs in the anterior urethra and is

probably the result of a failure of the urethral floor to close during fœtal life, a condition similar to that of hypospadias, or, as Watts suggests, a condition due to congenital stricture or phimosis.

Diverticula of the posterior urethra are probably always of the acquired type and usually traumatic in origin. Surgical procedures about the perineum either for the drainage of the seminal vesicles, as in Case 1, or for the removal of the bladder or prostatic stones, as in Case 4, are probably the most frequent factor in their formation. Frequently the falling astride some hard object with resulting rupture of the urethra or the formation of a hæmatoma with secondary rupture into the urethra results in their formation. Strictures are also an etiologic factor, both because of their tendency to cause dilatation posteriorly and because of the inaccurate passage of sounds in an attempt to dilate with resulting false passage and urethral rupture. Abscess formations in the neighborhood of the posterior urethra or in the seminal vesicles, as in Case 3, with secondary rupture and drainage into the urethra are frequently the origin of diverticula.

In cases in the literature a tumor at some point along the urethra is an almost constant finding, and the history of being able, by digital pressure, to express varying amounts of urine from such a mass is considered very suggestive. In our series but one patient (Case 4) gave such a history. This fact seems most pertinent, as our illustrations show to what size such diverticula may develop and yet give no physical signs; they even burrow under the bladder until they nearly equal it in capacity (Fig. 5). Lane reported several cases similar in character, found at necropsy, and Isaacs reported one that caused death by rupturing into the peritoneal cavity with resulting peritonitis.

Diverticula of the posterior urethra give a series of symptoms which are the result of a chronic inflammatory process going on in close proximity to the sphincter musculature and involving the urethra itself: (1) Dribbling or complete incontinence, depending on how near the diverticulum is to the external sphincter, and to the extent it has become involved in the inflammatory tissue produced by it; (2) dysuria resulting from the passage of urine through a constantly inflamed and irritated posterior urethra producing pain and scalding often accompanied by tenesmus; and (3) the presence in the perineum of a pocket filled with infected residual urine causing a constant feeling of discomfort often described as "resembling a ball of fire," which compels frequent urination in an effort to relieve.

Fig. 1. Lead catheter coiled in a diverticulum of the posterior urethra (Case 1).

That such diverticula may be overlooked is easily understood if it is realized that the condition is often associated with a normal bladder, as it was in three of our cases. Unless one uses an endoscope or a direct cystoscope, the floor of the posterior urethra may be overlooked. In Case 1 a cystoscopic examination had been made previous to our examination, and the patient was told that conditions were normal.

The etiologic factors in three of our four cases were the result of former operations for the drainage of infected tissue; in the other two the result of spontaneous drainage of abscesses into the urethra.

Case 1. (263163), C. E. M., a single man, aged 33, was admitted to the clinic March 12, 1919. The patient had had gonorrhœa four years before, and operations as follows: Drainage of seminal vesicles in 1917, followed by repeated injections of the epididymis on both sides with silver salts;

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 2. Bullet and fragments lodged behind the symphysis pubis, and lead catheter inserted into the diverticulum (Case 2).

Fig. 3. Lead catheter inserted into diverticulum filled with thorium; bullet fragment lodged behind symphysis.

Fig. 4. Similar to Figure 3; the diverticulum is filled with thorium, disclosing its extent and relation to the bladder, which is filled with silver iodide.

appendectomy June, 1918, and cystostomy December, 1918. He complained of dribbling and frequency. Following the neisserian infection he had tried various forms of treatment without result, and finally had had both seminal vesicles drained with complete relief for three months, when the old symptoms of dysuria, frequency and perineal pain returned, together with extreme nervousness, loss of weight, weakness, and nausea. His appendix was removed at this time, and six months later cystostomy with bladder drainage was done, both without relief.

Physical examination disclosed bilateral thickening of the epididymis and of the left vesicle. Analysis of a twenty-four hour specimen of urine showed 900 cubic centimeters with specific gravity of 1030, acid in reaction, a trace of albumin, no sugar, an occasional red blood-cell and large amounts of pus. The phenosulphonephthalein test of the kidney function showed a 60 per cent return of the dye in two hours. X-rays of the kidneys, ureters. and bladder were negative. The systolic blood pressure was 130; the diastolic 90.

Cystoscopic examination revealed a normal bladder with clean urine coming from each meatus and a normal internal urethral sphincter. In the posterior urethra just anterior to the verumontanum was an opening into a diverticulum filled with phosphatic deposit and pus. A lead catheter was coiled in the diverticulum (Fig. 1).

Operation was advised, as we believed that a diverticulum in this position, by keeping up a constant source of inflammation about the external sphincter and in the posterior urethra, would account for the dribbling and dysuria, and that it probably was a large factor in the causation of the patient's extreme nervousness.

CASE 2. (193464), W. C. S., a married man, aged 36, registered at the clinic May 8, 1917. The patient had had a slight neisserian infection of two weeks duration in 1901, appendectomy in 1900, and an exploration and drainage of the perineum following a rifle bullet wound in 1903. From the date of this wound, when a 22 caliber bullet entered the perineum and lodged behind the symphysis (Fig. 2), he had had constant pain in the bladder; the urethra discharged pus. The pain was exaggerated when the bladder was full or the abdomen was distended; it radiated to the glans penis during micturition.

Physical examination was negative except for a right inguinal hernia, a perineal scar, and a urethral discharge. The analysis of a twenty-four hour specimen showed 700 cubic centimeters, a specific gravity of 1020, alkaline reaction, a slight trace of albumin, no sugar, and a large amount of pus. The blood examination showed a negative Wassermann, hæmoglobin of 77 per cent, 4,500,000 red blood-cells, and 6,800 white blood cells. Repeated smears of the urethral discharge showed many pus cells but no characteristic gram negative diplococci. X-rays of the kidneys, ureters, and bladder were negative except for the presence of the rifle bullet and its fragments (Fig. 2).

Cystoscopic examination showed a normal bladder with clear urine coming from both meatus. The internal urethral sphincter was normal. In the posterior urethra to the right of the verumontanum was an opening into a diverticulum. Into this a lead catheter was inserted (Fig. 3). The diverticulum was then filled with thorium. Figure 4 shows the extent and position of the diverticulum in relation to the bullet fragments. The diverticu-

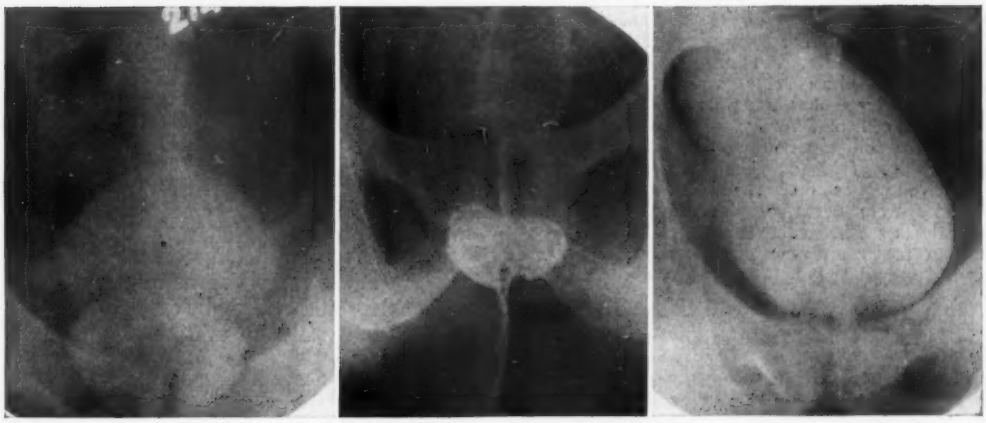

Fig. 5. Fig. 6. Fig. 7.

Fig. 5. Cystogram of bladder and of diverticulum of the posterior urethra (Case 3).

Fig. 6. Lead catheters coiled in diverticula of the posterior urethra (Case 4).

Fig. 7. Diverticula of posterior urethra filled with thorium, and the bladder filled with silver iodide, showing lax atonic bladder and the relative position of the two diverticula.

lum was evidently the result of the bullet wound, or of the subsequent drainage of the wound, and accounts fully for the painful urination and constant urethral discharge.

CASE 3. (214557), F. B., a married man, aged 40, came for examination November 21, 1917. The patient's history was negative except for an axillary abscess seven years before. Following an attack of inflammatory rheumatism four years before, he commenced to have attacks of dysuria which became more and more frequent and were accompanied by frequency and nocturia, all of which grew progressively worse until four months before, when he was obliged to wear a urinal. The passage of urine was attended with great pain and scalding. During the past four years he had lost much weight and strength; he complained of frequent night sweats and chills.

Physical examination revealed many signs of old tuberculous processes in the lungs, and a bar of hard, firm, inflammatory tissue about four inches up in the rectum. A twenty-four hour specimen of urine, 1550 cubic centimeters, gave a specific gravity of 1009, alkaline reaction, a trace of albumin, no sugar, many red blood-cells, and much pus, stained specimens of which failed to show tubercle bacilli. Four guinea pigs were injected with specimens of bladder urine obtained on different days and at necropsy one pig showed miliary tuberculosis foci throughout the peritoneum. The phenolsulphonephthalein test of kidney functions showed a 35 per cent return of the dye in two hours. X-rays of the kidneys, ureters, and bladder were negative; that of the chest showed calcified pleurisy at left base and a healed focus of tuberculosis at right apex.

Cystoscopic examination showed a chronic inflammatory tuberculous type of bladder with many areas of granulation tissue and cicatricial changes involving the internal sphincter, which was completely relaxed. On the floor of the posterior urethra just anterior to the verumontanum was an opening into a diverticulum about 3 centimeters in diameter. This, together with silver iodide and a cystogram (Fig 5), shows the diverticulum to be nearly equal in size to the bladder. The diverticulum probably was primarily an abscess in one or both vesicles which ultimately ruptured into the urethra. While the abscess cannot alone be considered the cause for all the present urinary symptoms, since the bladder is so extensively involved, it may well be the etiologic origin of them.

CASE 4. (26573), R. L. C., a married man, aged 49, came to the clinic April 1, 1919. The patient had had an operation for multiple bladder and prostatic stones in 1910. He complained of incontinence and perineal pain, and of always having had great difficulty in emptying his bladder, which seemed to lack musculature. Often he was obliged to double himself up and exert pressure superpubically in order completely to empty the bladder. In 1907 marked bladder irritability commenced, accompanied by dysuria and frequency. In 1910 the perineal operation was performed, and following this sphincter control was lost and he was obliged to wear a urinal. He has also had some difficulty in the control of gas and fæces if the bowels are loose.

Physical examination showed a well-developed man of 196 pounds, having a systolic blood pressure of 160, and a diastolic of 100. A transverse perineal

scar, and faulty closure of the arches of the sacrum were noted, which the X-ray demonstrated to be a spina bifida occulta. A twenty-four hour specimen of urine showed a specific gravity of 1020, alkaline reaction, a trace of albumin, no sugar, an occasional red blood-cell, and much pus. Blood examination showed 24 milligrams of blood urea pus in 100 cubic centimeters of blood. The Wassermann test was negative. X-rays of the kidneys, ureters, and bladder were negative. Neurologic examination revealed a saddle anæsthesia.

Cystoscopic examination showed a large atonic and trabeculated bladder with chronic diffuse cystitis and a relaxed sphincter. In the posterior urethra at either side of the verumontanum were the openings of two diverticula filled with pus and phosphatic deposit. The openings were large enough to permit the coiling of catheters in both at one time, thus giving the impression of a single diverticulum rather than two (Fig. 6). A second plate was made, the bladder having in the meantime been filled with silver iodide, in order to obtain a better idea of the relative position of the diverticula in relation to the bladder (Fig. 7). The diverticula in this case are clearly the cause of the perineal discomfort and explain the expressing of urine by perineal pressure. They are undoubtedly a result of the operation for the removal of bladder and prostatic stones.

CONCLUSIONS

1. Diverticula of the posterior urethra are generally of the acquired type.

2. Probably the most frequent etiologic factor is a previous perineal operation.

3. They give rise to a definite syndrome, namely, incontinence, dysuria, interrupted micturition, perineal pain, and pyuria.

4. The absence of a perineal tumor is not incompatible with their presence.

5. Since they may be associated with a normal bladder they may be easily overlooked unless the posterior urethra is carefully examined.

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TUBERCULOSIS OF THE ANUS

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TUBERCULOSIS is one of the terrible and destructive infections of the lower intestinal tract which may appear in a variety of clinical pictures. It may be primary or secondary. Primary tuberculosis of the anus or rectum appearing as the only evidence of phthisis in the individual is very rare. Secondary tuberculosis on the contrary, is quite frequently seen as a result of the swallowing of sputum by the patient who is suffering with pulmonary tuberculosis. In health the hydrochloric acid of the stomach will destroy the tubercle bacilli, but in the debilitated individuals, where the gastric secretions are of weak quality, the bacilli pass into the intestine unimpaired. Also the mucus of the sputum protects the bacilli in their passage through the acid gastric juice.

Anal tuberculosis. Tuberculosis of the skin about the anus may appear as miliary, ulcerative, lupoid or verrucous lesions. Miliary tuberculosis about the anus is very rare and occurs as a complication of tuberculosis of other organs. It develops as millet seed sized nodules grouped in crescents or circles, which begin in the hair follicles, sebaceous or sudoriparous glands of the skin. Later as the infiltrations enlarge, necrosis of the superimposed skin occurs and small cup-shaped ulcers with ragged borders appear. There is a slight discharge of seropus, but no bleeding. These ulcers usually continue as small single necroses but sometimes they coalesce into extensive wounds. Their blood supply is poor and they do not bleed on handling.

Ulcerative anal tuberculosis. Tuberculous ulcers at the anus begin insidiously. Sometimes there is a history of a known injury, although often this injury is so slight as to be forgotten until brought to mind by the examiner's questions. For example, a diarrhœa, horseback or bicycle riding, or a thrombotic hæmorrhoid has been followed by an area of induration at the anal margin which persists for a long time and finally ulcerates. The necrosis may begin on the external skin or within the anal canal. As the ulcer spreads it usually involves both the peri-anal skin and the anal mucous membrane. Tuberculous ulceration in the anal mucosa does not confine itself to a sulcus as does a fissure but widens out in all directions. The borders of these ulcers are clear cut, undermined, and pale with a ring of raised induration all about the ulcer. The base of the ulcer is irregular and gray in color and does not bleed easily. On the surface of the ulcer may be seen small yellow tubercles. There is not much pain with the passage of fæces or on the manipulation of examination. This is quite in contrast to the sensitiveness of the irritable ulcer. This freedom from pain distinguishes the tuberculous ulcer from fissure, chancre, mucous patch and rodent ulcer. The discharge is scant and thin and but rarely is tinged with blood.

The clinical course of these ulcers varies greatly. Some extend slowly while others spread rapidly and destroy all structures. Unlike syphilitic ulcerations there is no healing at one spot while ulceration progresses at another, but rather the tubercular ulcer spreads continuously in all directions. The ulcer is not usually fatal but it contributes to the general breakdown of the patient.

Case 1 is a typical history. M., age 43, occupation, retail grocer clerk; nativity, Irish American. In June, 1915, he showed pulmonary tuberculosis and has been under institutional care almost ever since. In August, 1916, he suffered with hæmorrhoids which prolapsed for several days and were finally replaced by a physician. The patient applied an ice bag to the anus almost continuously thereafter for the next four weeks, and about that time noticed a marginal abscess. The abscess was opened but did not heal and has continuously discharged since that time a thin, watery, or sometimes a yellowish excretion. There is no pain at stool or on walking and but little pain after the manipulations of dressing the wound. This patient has active pulmonary tuberculosis and is losing weight.

On inspection we found an ulcer at the mucocutaneous junction in the posterior quadrant of the anus and to the right of the median line. It was

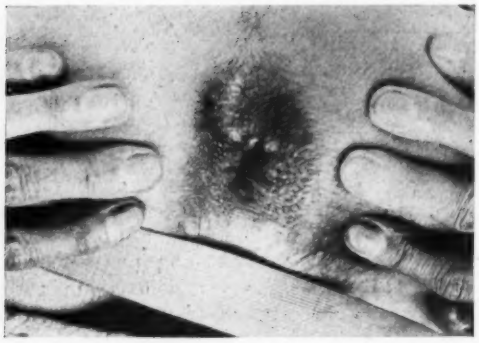

Fig. 1. CASE 1.

one-half an inch wide by one inch long and extended up into the anus and out on the skin. Its edges were irregular and rolled in. Its base was dry and glistening, not bleeding, and was without any points of granulation (Fig. 1).

CASE 2 also has active pulmonary tuberculosis. His history is very similar to Case 1 and his ulcer also very typical (Fig. 2).

In both of these cases the possibility of tuberculosis is forced upon us by evidence of the disease elsewhere.

Lupus at the anus. Lupus was long considered a syphilitic manifestation but is now known to be tuberculous. It is slow in spreading but in its aggravated type is terribly destructive of tissue. The disease begins at the mucocutaneous junction at the anus or vulva as a small, soft, reddish-brown nodule in the corium (apple jelly ulcer), which later breaks down into a small, clear-cut ulcer, irregular in outline and having an indurated base. A cheesy, pus discharge can always be found in some of the affected area. Cicatrization appears in some ulcers at times but it soon breaks down and the ulceration extends wider. A dense fibrous infiltration beneath the ulcer seems to prevent its deepening but does not interfere with lateral spreading which may be caused by enlarging of the individual ulcer or by the coalescence of small ulcers into large ones.

Differential diagnosis. Lupus is to be differentiated from cancer and syphilis. Cancer rarely occurs in early life and if it does it runs a very rapid course. On the contrary lupus frequently appears in children and persists to adult life. The base of the cancer ulcer is pearly white, indurated, uneven and glazed, and its edges are everted. Lupus ulcers are usually multiple, have soft, insensitive bases and edges covered with granulations. The secretions of a cancer are scanty and fetid while the discharge of a lupus sore is profuse and odorless.

Pathology of tuberculous ulcers. At the terminal bowel tuberculosis produces the usual inflammatory changes together with intense and rapidly developed proliferation. When the bacilli and their toxins are present in sufficient numbers the whole area dies and is coagulated. The first evidence of the tubercle bacilli in the tissues is the development of translucent gray nodules. The single tubercle is so small as to be hardly visible to the human eye. These tubercles have a tendency to group together and coalesce into rounded or mulberry-shaped masses about the size of millet seeds (miliary tubercles), or they may be as large as walnuts. These masses at first are firm in substance but later undergo caseating necrosis in which calcium salts may be deposited and the whole converted into a mortar-like substance. More often, however, the mass softens, probably because of secondary infection, and an abscess results. Healing may take place even now by inspissation of the necrotic material and the formation of a dense surrounding capsule of tuberculous scar tissue. If healing fails the abscess ruptures, a yellow opaque substance is discharged and there is left an ulcer with ragged, nodular, thickened and undermined edges. Its base is generally covered with yellow, necrotic material which when removed exposes the tuberculous granulation tissue which lines the ulcer. This ulcer may extend to the deeper coats or even perforate the bowel. At the anus the ulcer may extend to the subcutaneous connective tissues.

On the skin about the anus and the mucous membrane within the rectum there may develop tuberculous granulation tissue. This mass is highly vascular and is produced as a reaction to the tubercle bacillus. Although it is well supplied with blood-vessels, this tissue has a strong tendency to undergo caseation necrosis. This caseating mass may be heaped up above the level of the surrounding tissues.

About this mass a dense fibrous layer may form which ultimately may heal over completely as a hard, contracting scar, provided new granulations do not form.

Tubercle bacilli may be transported through the body: (1) mechanically along with air, food or secretions and in the digestive tract by the action of gravity or muscular activity; (2) by extension from neighboring growths; (3) by lymphatic and blood streams.

By these avenues great numbers of bacilli and their toxins may be suddenly thrown into the body causing an acute tuberculous septicæmia or as otherwise called acute miliary tuberculosis. From intestinal tuberculosis the mesenteric lymph glands or even the ductus thoracicus may be involved.

Treatment of tuberculosis at the anus. Prophylaxis is all important. The tuberculous patient should be thoroughly and repeatedly impressed that it is through swallowing the sputum that the bowels become infected. Various procedures have been carried out hoping to produce immunity but the use of tuberculin and also the transplanting of tuberculous lymph nodes into normal animals have both been unsatisfactory. When infection and ulceration have occurred, medication by mouth is not beneficial. These patients have poor digestion and unpalatable drugs by mouth further upset the appetite.

Treatment of anal ulcerative tuberculosis. If the patient's initial tubercular lesion is of moderate extent or is not active the ulcer may be thoroughly curetted with the Paquelin cautery, removing all of the necrotic tissues of the edges and base of the ulcer. I prefer the cautery to the knife as by that means the lymphatics are sealed beyond and dissemination is prevented. Thus we improve the patient's resistance. Following the cauterization the anus should be exposed to the sunlight and air for several hours each day. The patient can soon be taught how to spread the nates and expose the anus. If any part of the body which is normally covered shall be thus suddenly exposed directly to the sun's action blistering and painful tanning occurs. Therefore during the first few days the nates should be covered with a cotton sheet, later this is replaced with three layers of cheese cloth, one layer of which is removed after a few days, the second a few days later, but at least one layer of cheese cloth should always cover the parts as a screen against the action of the sun. It is remarkable how quickly relief and healing take place. When a patient is weak and we think not equal to the cauterization even under local anæsthetic, surprising results may be obtained by exposure to the sun.

Fig. 2. CASE 2.

Treatment of lupus at the anus. Most satisfactory results are obtained by phototherapy (Finsen light), concentrating the light rays on a small area of skin for about an hour. The next day a small blister appears and this is dressed with a soothing ointment. After all irritation has subsided another exposure is given. The treatment is very tedious. The roentgen-ray also produces good results and is sometimes more convenient. Its action is pushed to the extent of producing a burn which is then protected with a soothing dressing. The scars following either of these plans of treatment are much less objectionable than those of any other plan of procedure.

SYMPUS APUS

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THIS still-born monster was delivered at the Lying-in-home at 8:10 p. m. on January 25, 1919, and sent on to the Pathological Museum of the Ceylon Medical College for preservation. Sympus may be defined as a monster in which the lower limbs are fused together, to a greater or less degree and with an imperfect development of them and of the neighboring pelvic organs and pelvis.

Synonyms: sirenomelus and symelus. The terms "mermaid fœtus" and "fœtus with a tailed appendage" have also been employed. None of these terms is quite so good as "sympus," which indicates the fusion of the lower limbs as the essential feature of the anomaly. Symelus, for instance, simply means a monster in which the limbs, upper or lower, are fused. To adopt the terms "sirenomelus" or "syreniform fœtus," is to liken the monstrosity to a fabulous creature (the Siren), and is scarcely scientific. "Sympus," is therefore the most appropriate name.

Classification (1). According to Geoffroy Saint-Hilaire, this monster belongs to the class, single monsters; to the order, autosites; to the family, teratomelians; and to the genus, Symelians. (2) According to Forster, this belongs to the class sympus apus, in which the fused lower limbs end simply in a tapering point (as in this case) or in a stump like that seen after an amputation.

Obstetric History. In this case pregnancy seemed to have terminated prematurely, the fœtal movements were sluggish, and toward the end of pregnancy not felt at all. Liquor amnii was small in quantity. The labors are, in these cases often easy; delay, when it does occur, is commonly due to an associated malformation, for instance, hydro-

Photographs and roentgenogram of author's case.

cephalus or to a malpresentation. When the fused lower limb presented, as it sometimes did, the diagnosis of presentation was thrown into doubt.

Clinical History. None of the recorded infants survived its birth for more than a few minutes, or at most hours. This is not surprising, when we consider the abnormal conditions discovered by dissection. But Cichorius has recorded an interesting case of Siren formation—the child living for a week, after birth—in Leipzig clinic.

The morbid anatomy is a somewhat complicated subject.

1. *External appearances.* The fused lower limb is usually directly continuous (as in this case) with the lower (subumbilical) part of the trunk and it is flattened anteriorly and curved posteriorly. It is capable of being folded upward upon the anterior surface of the trunk; in one of the recorded cases, the fused foot lay over the right shoulder and near the right ear. The lower part of the abdomen shows a tendency to narrow as it approaches the lower limb and this tendency along with the form of the fused limb, gives to the fœtus its "cuspidate appearance," i. e., ending in a point. There is no trace of external genitalia. Posteriorly there is a linear depression with radiating furrows which possibly indicates a rudimentary anal aperture. The body of this monster above the umbilicus is normal.

2. *The conditions discovered by dissection are interesting.* The sacral and coccygeal vertebræ are less in number and the sacrum as a whole, is tilted upward, the ilia are spread out laterally, so that the anterior superior spines are directed to the sides and downward, their fossæ are flattened. The tuberosities of the ischia are turned inward and their ascending rami are joined in a horizontal plane with disappearance of the obturator foramina. In front of the ischia there is a projecting crest formed by the horizontal rami of the pubic bones. The ischial and pubic bones unite to form a mass which blocks the pelvis and shows a wide cotyloid cavity for the reception of the large head of the fused femora. It is on account of these conditions that Taruffi places sympus among the pelvic monstrosities (Lecanoterata). A careful study of the lower limb after dissection shows the following:

The femora are completely fused with a single large head fitting into a single cotyloid cavity, with two condyles articulating with a single tibia and no fibula.

The evidence of two bones in the thigh is well shown by the two nutrient foramina (seen in the roentgenogram), which are present on the post aspect of the femora, which are rotated in such a manner as to bring the external surfaces internal, and posterior surfaces anterior, and the knee flexes anteriorly. There is no foot at all.

The pelvic organs are absent, that is the kidneys ureters, bladder and the genital organs but the right suprarenal capsule is present. The rectum and the vermiform appendix are also absent, the descending colon ending blindly. The urachus is wanting. The umbilical cord has only one artery and one vein.

Putting all these facts together we may come to the conclusion that in sympus the derivatives of the allantois (urachus and part of bladder) and its vessels (umbilical arteries and veins) are usually absent and that the vessels of the cord are omphalomesenteric or vitelline in origin.

Sympodia is relatively somewhat rare, only 116 instances were gathered together up to 1897. This variety—sympus apus—is rarer still.

The teratogenesis is a subject which has been fruitful in ingenious explanations and yet cannot be regarded as in any degree settled. There is no explanation offered for the extraordinary rarity, the almost complete absence of any cases of sympodia in the lower animals.

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EARLY SURGICAL AND ORTHOPEDIC TREATMENT OF HEMIPLEGIA[1]

By JOSEPH BYRNE, M.D., M.R.C.S., ALFRED S. TAYLOR, M.D., F.A.C.S., and SAMUEL W. BOORSTEIN, M.D., New York

Neurological Standpoint

By Joseph Byrne

THE prevention of deformity and disability in hemiplegics by early surgical and orthopedic measures, though not new to the profession, has not received the attention it deserves. The possibilities of group treatment along the lines set forth in the following pages are especially written in the case of disability from war injuries, and it is mainly with the hope of stimulating interest in this direction that we have undertaken to publish the results obtained during the past few years in the First Surgical Division of Fordham Hospital.

Hemiplegia is the immediate result of suspension of function in the upper motor system of neurons. The usual cause is some serious interference with the circulation (hæmorrhage, embolism, thrombosis); the mechanism consisting of:

1. *Direct lesion*—severance or changes in the paths consequent on impaired blood flow (contusion, laceration, necrosis, etc.).

2. *Indirect lesion*—compression of the paths as the result of hæmorrhage, œdema, etc.

3. A combination of (1) and (2).

Although not commonly found as a sequence of skull injuries, hemiplegia is occasionally met with as the result of compression from extradural hæmorrhage of traumatic origin, from neoplasms, and from cystic formations that sometimes follow intradural hæmorrhage. Compare the large hygromata described by Virchow, which develop in conjunction with the repeated extravasations in *pachymeningitis hæmorrhagica interna*.

[1] From the First Surgical Division of Fordham Hospital, New York. The operations were performed by Alfred S. Taylor (with the exception of two cases). The neurological examinations were done by Joseph Byrne. The orthopedic care and after-treatments were carried out by Samuel W. Boorstein. Paper read before the New York Neurological Society and Neurological Section of Academy of Medicine, March 5, 1918, and before the Bronx County Medical Society, March 20, 1918.

ANATOMICAL AND PHYSIOLOGICAL REMARKS

The mechanisms involved in the production and symptomatology of hemiplegia call for a few words as to the anatomy and physiology of the parts involved. The dura mater over the convexity of the brain consists of (1) an inner, more or less dense, fibro-elastic layer containing many connective-tissue cells and lined on its inner surface by a single layer of flat cells; (2) an outer layer like the inner layer but more richly supplied with blood-vessels and nerves. Between the inner and the outer layers lie the large venous sinuses. The dura acts as the inner periosteum for membranous cranial bones. On the convexity of the skull it is attached to the bones and can be readily detached without rupture into the subdural space. It is because of these facts that fractures of the vault are usually simple whereas fractures of the base are invariably compound. The separability of the dura from the bone at the convexity plays an important rôle in the mechanism of extradural hæmorrhage from rupture of the middle meningeal artery or of one of its branches. Because of their wide spreading terminal ramification in the dura, the combined tensile strength of the smaller arteries greatly exceeds that of the parent stems, which are more or less firmly anchored at or near the origin of the middle meningeal from the internal carotid just outside the foramen spinosum. When, therefore, the shape of the cranium is temporarily altered by a blow or fall, e.g., on the side of the head, the distance between the origin of the artery and the site of its terminal ramifications is suddenly increased, the artery itself or one of its primary divisions is put on the stretch and ruptures at the point of least resistance. Coincident with this there occurs a displacement, partial or complete, of the loosely attached outer layer of the dura on the convexity or side of the skull

With the rupture of the artery, hæmorrhage sets in which tends to continue not so much from failure of coagulation as from the difference in pressure conditions obtaining within the artery (normal blood pressure) and without it in the extradural space (where the pressure is practically nil). In this latter, after primary displacement of the dura on the bone or even without such displacement, the adhesive force binding the dura to the bone more nearly approaches the expanding force of the venous than that of the arterial pressure. The result is a steady *flow* of blood into the extradural space in spite of a normal tendency of the blood to coagulate.

Another important anatomical point is the type of blood supply found in the cortex and within the brain. On the cortex, owing to the free arterial anastomosis there is a rich collateral blood supply through which moderate disturbances in the circulation at any point may be readily compensated. On the other hand, the arteries entering the base of the brain, from the circle of Willis through the substantia perforata anterior and posterior to supply the basal ganglia, centrum ovale and internal capsule are all "end arteries," so that lesions (necrosis, softening, etc.) in these regions resulting from circulatory failure or obstruction, are likely to be permanent as there is no provision for compensation through collateral blood supply. This fact taken in conjunction with the condensation of nerve paths that occurs in the internal capsule and in the ventrolateral aspect of the thalamus, gives serious significance to the relatively small lesions occurring in the vicinity of these organs.

PATHOLOGICAL REMARKS

Pressure upon the cortex from hæmorrhage, extradural or intradural, sufficient to cause hemiplegia usually terminates in death if unrelieved. The mechanism here is obstruction of the capillary circulation in the medulla with consequent strangulation of the vasomotor and respiratory centers.

Remote causes. Small intracerebral lesions in the vicinity of the internal capsule may cause hemiplegia by increasing the intracranial pressure to a degree that may even threaten the medullary centers. In any lesion following trauma, the œdema of repair may add its quota to the general burden that may already hamper the medullary centers. In severe cases of contusion this may be the deciding factor of life or death. In such lesions also, secondary hæmorrhage may occur as the result of rupture of damaged vessels (traumatic apoplexy). This also may be a vital factor in determining the issue.

The main problem in the cases under consideration, from the point of view of early surgical interference, is the relief of intracranial pressure that menaces life or hampers restoration of function. For some time past, one of us (Byrne) has been studying clinically and experimentally the respiration as an index of increased intracranial pressure. From studies it has been concluded that the apnœic period in Cheyne-Stokes respiration is the result, not of the fall in arterial pressure (capillary anæmia) as Cushing asserts, but of a deficiency of carbon dioxide, (over-aeration). In our experiments the sequence of events most usually observed in the kymographic tracings was: fall in blood-pressure, enhanced respiratory movements, rise in blood-pressure, apnœa (diminished carbon dioxide), fall in blood pressure and so on. The whole respiratory mechanism serves ordinarily to a large extent as an auxiliary of the circulation, aiding by its thoracic pumping action blood movements from abdomen to chest, and from chest to medulla. But what we would particularly call attention to here, as an index of disturbed medullary circulation, is that modification of the respiratory movements which consists mainly in a *relatively prolonged and more or less accentuated expiratory phase.* To make accurate observation of this, we have been in the habit of using a stop watch and timing the different phases of respiration as follows: (1) from the beginning of inspiration to the beginning of expiration; (2) from the beginning of expiration to the beginning of inspiration; (3) period of rest. Where the medullary centers are in distress, expiration, which often appears as diphasic, i.e., divided into two distinct acts, is prolonged at the expense chiefly of the period of rest, which may be completely

absent, but also in part at the expense of inspiration. This type of breathing is different from the normal. Wherever it is present it gives cause for concern and it is always a welcome sign in any kind of illness in which it is encountered, when there is a tendency toward a return to the normal.

This altered ratio of inspiration and expiration may be accompanied by mild phasic periods suggestive of beginning or modified Cheyne-Stokes respiration. It may be stated here that in animal work where the respiration ceased it was always the expiratory mechanism that gave out first. This seems relevant in view of the fact that overaction of this very mechanism is the chief feature of the clinical and experimental phenomenon to which we call particular attention.

INDICATIONS FOR OPERATION

In some of the cases, such as those found in intradural hæmorrhage, traumatic or spontaneous, the greatest care should be taken to study the effects of the increased intracranial pressure and the capacity of the brain and cord to make compensatory adjustments. The pulse rate, blood pressure, and eye grounds should be systematically studied from hour to hour, or even more frequently, to determine how the medullary centers are withstanding the strain. Above all, the behavior of the respiratory center should be carefully watched as this is the most sensitive of the medullary mechanisms to alterations in intracranial pressure.

From the moment the medullary mechanisms give unmistakable indications of being unable to cope with increased intracranial pressure, surgical intervention is to be regarded as a conservative measure.

The foregoing remarks apply to lesions which in addition to causing hemiplegia also threaten life. But operative interference may be indicated in lesions which, because of marked focal pressure, may cause permanent paralysis or deformity. Such lesions are mainly of the intracerebral type, those most suitable for operation occurring in the vicinity of the internal capsule where a very small lesion so readily causes permanent hemiplegia.

Three types of vascular lesion, of traumatic or spontaneous origin, demand consideration of the surgeon: (1) extradural, (2) intradural, (3) intracerebral.

The *extradural* lesion is often limited practically to hæmorrhage from the middle meningeal artery or one of its branches. In its typical course the clinical picture of the condition is very characteristic with its primary period of unconsciousness due to compression. These phenomena are accompanied by signs of progressively increasing intracranial pressure which when maximally exerted on the motor area may cause in sequence: (1) primary focal anæmia, which finds expression in focal irritative signs such as twitching, etc.; (2) general anæmia, showing itself in general compression which manifests itself as generally inhibitory phenomenon, e.g., hemiplegia, general paralysis, etc.

In some cases extradural hæmorrhage may be associated with cerebral contusion direct or from contrecoup and the clinical picture will be a composite of the two conditions. In these cases the intracranial phenomena should be studied along the lines laid down for *compression*. The pulse rate, blood pressure, respiration and eye grounds should be studied from hour to hour and the presence or absence of irritative or paralytic signs noted. A leucocyte and differential blood count are also of value in diagnosing contusion and the advent of infection, etc. The spinal fluid often yields important information but if unpleasant after-effects and serious accidents are to be avoided, the utmost care has to be used in making the lumbar puncture, and the fluid withdrawn intermittently, slowly and in small quantities through a small needle, the patient's head being lowered and the hips raised (where there is reason to fear sudden or undue pressure on the medulla from alteration of hydrostatic conditions obtaining within the craniospinal cavity).

In intradural lesions of traumatic origin the hæmorrhage is usually venous and tends to become checked automatically without seriously threatening the medullary or other mechanisms. Such conditions, however, are usually associated with contusions of greater

or less extent and the resulting *œdema of repair* as well as the incidence of secondary arterial hæmorrhage (traumatic apoplexy) are matters of concern and may call for operative interference (decompression), which in many instances the operator will find it to his advantage to make upon the sound side of the head as a precaution against further hæmorrhage. Intradural hæmorrhage does not usually cause hemiplegia or focal pressure signs, although under certain circumstances (œdema, traumatic apoplexy, etc.) it may.

Though, in general, early operative interference is contra-indicated in intradural hæmorrhage, nevertheless resulting intracranial conditions such as general pressure, focal pressure, the possibility of cystic formations and growth, etc., may outweigh all other considerations. Spontaneous intradural hæmorrhage is usually of arterial origin and where it is large enough to cause hemiplegia it usually destroys life, if the intracranial pressure be not relieved by surgical measures in time to prevent medullary strangulation.

There are many conditions, e.g., paresis, pachymeningitis hæmorrhagica interna, etc., in which numerous repeated small intradural hæmorrhages occur presumably from miliary aneurisms with immediate effects that are usually but slight and transient. In any of these conditions menacing symptoms may appear at any time and operative measures may be indicated.

It is worth while recollecting that intracerebral hæmorrhage of traumatic origin may result from injury to the vessels with subsequent delayed hæmorrhage (traumatic apoplexy), or from early decompression operations for intradural hæmorrhage accompanied by contusion; or from gunshot wounds or the injudicious use of sharp pointed exploring needles. It may occur anywhere in the brain but is usually found in or near the cortex and generally associated with subdural extravasation.

Intracerebral hæmorrhage of spontaneous origin results from arterial degeneration (arteriosclerosis, endarteritis, tumors, gliosarcomata, etc.). By far the great majority of spontaneous hæmorrhages result from arterial disease of the intracerebral type and occur as Charcot pointed out, in the vicinity of the internal capsule as the result of rupture of the so-called lenticulostriate artery (artery of cerebral hæmorrhage). Small hæmorrhages in this vicinity may cause widespread sensory and motor disturbances due in part to direct lesion of the nerve paths (laceration, softening, etc.), and in part to focal pressure from arterial hæmorrhage followed at first by clot formation and later by cysts which may grow. These possibilities suggest at once surgical intervention as a means of preventing deformity and disability. Removal of the small clot, and of the collection of serum surrounding it is often readily effected by the mere passage of a moderate sized Cushing exploring needle through the brain substance. This relieves focal pressure and prevents degeneration of tissue as well as cystic formation both of which contribute so largely to the extent and permanency of disability.

We would particularly emphasize at this point the need of making careful studies of the newly born and of all infants and young children in whom there is reason to suspect intracranial complications from trauma, infectious disease or other cause. In any of these conditions valid indications for operative interference may be found, and it is at or near the onset of the trouble that the best results are to be obtained, if we seek to prevent cerebral maldevelopment and the train of mental and physical disorders that is so commonly associated with it.

An early operation even if its purpose be merely to effect decompression may so relieve focal compression as to restore the circulation of the blood and cerebrospinal fluid in important structures and thereby promote nutrition and growth in tissue that would otherwise degenerate or remain stunted. Although operative interference has been recommended and may be of benefit in intracerebral thrombosis and embolism it is chiefly in conditions of hæmorrhage that its best indication is found.

DIFFERENTIAL DIAGNOSIS

A few points of differentiation between these different conditions are *apropos:*

a. Hæmorrhage. Age over 45; onset sudden, during effort; arteriosclerosis present; high blood pressure.

b. Thrombosis. Age under 45; onset during rest or sleep, etc.; endarteritis present. Heart enlarged to the left; normal or lowered blood pressure; luetic myocarditis; onset is not so sudden and distinct as in hæmorrhage.

c. Embolism. Age under 45; onset sudden on exertion or after taking circulatory stimulants. History of infection of tonsils, etc.; rheumatic endocarditis; neoplasm; trauma; pulmonary and other types of embolism; heart enlarged to right; myocarditis; decompensation; auricular fibrillation; paralysis may have intermission.

Surgical Standpoint

By Alfred S. Taylor

The paper by Dr. Byrne has brought out very clearly the indications for the operation and also showed how these cases have been studied. When the patients are presented, the methods used in each case will be discussed so as to bring out clearly all the facts about the surgical and orthopedic measures employed. The main object in presenting these is to stimulate interest in the early treatment of hemiplegia.

We do not claim that the work is original. A case was reported in 1911 by a railroad surgeon in Pittsburgh who operated on a railroad conductor. Some months after the operation the patient showed no evidence of ever having had trouble with the central nervous system. Hudson reported eight or ten cases. The method used is the ordinary subtemporal decompression with evacuation of the clot. A piece of bone two by three inches is removed, the dura is opened and, if the clot is in the brain, a grooved director or a Cushing exploring needle is slipped in at the site of the clot and the latter extrudes of itself. It is not necessary to go into details about the steps of the operations as they are well known. The principal point is this: If one can get good results from patients with hemiplegia of long standing, by a subtemporal decompression as will be shown in some of our cases, this operation seems desirable in recent cases of hemiplegia. It will save them from a great deal of pressure and destruction of brain tissue, also from the usual spasticity of the muscles with resulting contractures.

It seems logical that decompression with evacuation of the clot should give all the recovery that can be gotten in hemiplegia and ten times as rapidly as by waiting for the clot to be absorbed. One may argue that it is not advisable to add the danger of operation to the pathological condition of the patient. This, however, is an erroneous idea. The operation is comparatively a slight one, no anæsthesia is needed, the unconscious patient standing the operation well. There is no shock and very little bleeding. The whole thing is of little menace to the patient. It has been done several times by me without anæsthesia. We wish to emphasize that there is no shock attached to the operation and the operation itself is not dangerous. If a clot the size of an English walnut had formed in the brain (as in Case 4 of our series), manifestly the best thing to do would be to remove the clot and nature would have a better chance to bring about restoration. In a fair number of cases, there will be much greater improvement than by expectant treatment and it is worth while to give the patient the benefit of the doubt.

Even in cases of thrombosis, this operation may be tried as the area of necrosis in the region of the obstructed vessel will be benefited by any procedure which diminishes or alters focal pressure conditions and therefore favors the establishment of collateral capillary or perivascular circulation.

One must always consider the possibility of cystic formation (as demonstrated in Case 4), and the pressure which might be degenerated by the activity of secreting cells throwing their output into a tightly sealed cavity.

Orthopedic Treatments: Prevention and Correction of Deformities

By Samuel W. Boorstein

Everyone knows that after an attack of apoplexy, the victim becomes an invalid and a deformed cripple. Either he is not able to walk at all and is compelled to remain in bed during the rest of his life or if he recovers and is able to move about, his gait becomes abnormal and his paralyzed limbs often become deformed and distorted. Even the layman will call such a patient a "real cripple." Still how often is the attempt made to prevent and correct these deformities by the early application of orthopedic principles as in the case of other diseases where deformities result as exemplified in anterior poliomyelitis and spastic paraplegia.

The attending physician usually watches the case for three to four months and is satisfied with the improvement attained at that time. If the patient is then able to get around, the physician considers it a good result. If contractures develop, he considers that as an inevitable evil and accepts it as a matter of course.

It is for the purpose of interesting the profession in the early and proper orthopedic treatments that this part of the paper is written.

Let us at first survey briefly the deformities that occur in hemiplegia:

The distal segments of the limbs, the feet and the hands, are affected more often than those near the trunk. At the onset of the attack there is sometimes a temporary initial rigidity of the muscles of the paralyzed side, or an "early" rigidity may develop in one or two days. At about the second week, there is always a "late" rigidity. This, which at first is slight, gradually increases and finally contractures affect the paralyzed limbs. The shoulder is adducted. The forearm is bent at a right or an acute angle, the hand usually pronated and slightly flexed, the proximal phalanges slightly flexed, the middle and terminal phalanges more so. The fingers are tightly shut into the palm of the hand. If an endeavor is made to straighten the forearm, the muscle tension has to be overcome; this may be wholly or only to a certain extent successful but the forearm immediately returns to its former posture. The flexed fingers can be extended only if the wrist is put at first in extreme flexion. In the lower extremity the hip is adducted and internally rotated. Contracture of the knee is not very rare. The foot presents marked deformities. The tendo achillis is contracted and the foot is in the posture of talipes equinovarus, i.e., heel up, toes down and turned inward. The rule seems to be that the larger flexor groups of the extremities and the adductor muscles are selected. It is probably the disparity in strength between the flexors and extensors that determines the contractural postures as a result of the hypertonic condition of the muscles.

In discussing the treatments of the paralyzed limbs, the text books on neurology do not sufficiently emphasize the necessity of preventing contractures.[1] Some do mention that splints should be applied but the importance of this is neither impressed upon the reader nor are the details of application given. Others (Foster and Oppenheim, 13) are on the contrary satisfied that the position of the paralyzed limbs should frequently be altered to avoid contractures. Some add massage and passive movements to prevent the evil consequences of deformities. Tilney (17) emphasizes more in detail the use of the splints. Still how many physicians have ever put a splint on a patient's hand or foot at the onset of a stroke of paralysis? On the contrary they discourage the use of splints or plaster.

In the neurological service at Montefiore Home and Hospital where we always have about 60 to 70 patients with hemiplegia, I have not met even one patient who gave a history of having been watched by his attending physician immediately after the apoplectic attack for contractures. It is there that my interest was first aroused in these cases. Dr. Elliott and myself had abundant opportunity to verify the observations that Mink had made on monkeys and we found to be true

[1] The writer has consulted the following textbooks on neurology: Dana, C. L. (7); Starr, M. A. (14); Cushman, H. (5); Church and Peterson (6); White and Jelliffe, (9); Oppenheim, H. (13). These books are the usual ones used in this country by the physicians and students. Thus very little impetus is given to the orthopedic treatments.

in human beings that in the early stages the contractures can be remedied and likewise in old and neglected hemiplegics, great improvement can be obtained. We have treated there a practically bedridden invalid with marked deformities, i.e., flexion of the thigh on the abdomen, and of the leg on the thigh with the foot in marked posture of talipes equinovarus, of 21 years' standing, and succeeded in making him walk. He is able now to walk for a considerable length of time. I have reported the case in detail together with Dr. Elliott in the *Journal of the American Medical Association*, 1916 (8). The method was then tried on a few early hemiplegics and we have likewise succeeded in overcoming their contractures.

After Dr. Taylor had operated on the first patient in this series of hemiplegias and had seen the beneficial result, it was decided by the three of us to make use of the orthopedic principles that were employed by Dr. Elliott and myself at the Montefiore Home and Hospital. These treatments were, therefore, instituted at the same time that the operation on the skull was done or usually a few days after the operation. We found that it is much better to apply splints immediately.

Technique. The lower limb was put in a plaster cast extending from the toes to the perineum. The foot was at right angle to the leg and the knee extended. Though Tilney (17) claims that full extension of the leg on the thigh not only causes an unnatural position of the body but by producing an unusual strain on the muscles will prove fatiguing, it seems to us that the discomfort of the patient should be sacrificed for the prevention of the knee contraction. Hoffa, of Berlin, Lazarus and others have distinctly recommended the use of splints in hemiplegic paralysis of the leg, with elastic bands to replace the deficient flexion of the knee and to insure dorsal flexion of the foot.

If one is really looking for the comfort of the patient, he may order a brace with a drop ring to permit bending of the knee when required and to allow its extension on walking. As a point of interest, I may mention the case of a patient with multiple neuritis who had been receiving in Montefiore Home and Hospital, massage, exercises, and electrical treatments for three years but had not been able to stand on his feet. On application of plaster casts to his knees he felt more secure in his attempts at walking and within 2 to 4 weeks the splints were discarded and the patient walked freely. We can, therefore, conclude that plaster casts for the knee will give the patient a certain security and thus encourage early walking. To prevent adduction of the hip, we simply put sand bags or pillows between the knees.

For the upper extremity, the shoulder is kept abducted to a right angle, by placing sand bags near the chest, or one may put the shoulder on a wire splint or a plaster spica, or a Jones abduction splint which is so easy to apply. In choosing the best position for the elbow one has to remember that the tendency is for flexion at a right angle or an acute angle and it would, therefore, be natural to place it in a straight line (full extension) but this would interfere with the use of the limb, as people cannot have much use of a straight arm. It seems logical to place it in a position midway between flexion and extension, e.g., at an angle of 135 degrees. This is simply an arbitrary figure with us. The forearm is put in full supination.

The hand deformity is the hardest to handle and really requires more guarding than the other parts of the linbs. The recovery is also less certain. It is therefore of paramount importance to have the hand slightly hyperextended at the wrist, say to an angle of 165 degrees, while the fingers are straight, but in order to prevent hyperextension of the metacarpophalangeal joints, these may be slightly flexed. This position can be retained in a plaster splint, in a Jones "cock up" splint or Taylor splint (Fig. 4). All these contrivances or splints not only prevent contractures but also help a great deal to relieve the painful cramps so commonly found in these conditions.

These temporary splints are left on without disturbance until one is ready to begin with massage. If plaster has been used, it is then cut into halves and removed for massage and exercises. If the patient can afford it, braces can then be applied so that it will be easier to

remove them. If braces have been used from the beginning, of course no change is necessary.

The question of prevention of contractures arises only in persistent hemiplegias. There are rare cases where the resultant paralysis is flaccid, i.e., in extensive foci which involve both motor and sensory cortical areas. The muscles retain their posture but undergo moderate atrophy. These cases, of course, need no splints, but one is not certain whether it will be a flaccid or spastic paralysis; hence prevention is important.

MASSAGE AND EXERCISES

Massage and exercises form a very important part in the treatment of the affected limbs and it is essential to obtain more definite ideas as to the time, duration, frequency, and forms.

When to begin massage. No specified time can be given. Bucholz (2) advises massage as early as the second day, with the idea of lowering the tension of the blood-vessels, but it requires the utmost care. Oppenheim (13) on the other hand advises massage two or three weeks after the apoplectic stroke. The general opinion is to begin about two or three weeks after the attack. This was our custom where we had a chance to treat the patients immediately after the apoplectic seizure.

Forms of massage to be used. Oden (12), in an excellent article on "Systematic Therapeutic Exercises of Paralysis in Hemiplegia," where careful observations and experiments are reported, shows that "general massage" as used by the masseuse does not bring the desired effect, and on the contrary is distinctly harmful. He emphasizes the fact that certain muscles are flaccid and others spastic; for instance, the upper extremity shows spastic paralysis of the flexors and flaccid of the extensors.

The form of massage to be used for spastic muscles must be different from that used for flaccid. (For contracted or spastic — effleurage should be used; while for the relaxed muscles — petrissage and tapotement.[1])

[1] I am using the terms advocated by Bucholz and not the terms advocated by Oden.

"Thus when there is a contraction, the muscles should be treated by effleurage of a very light form, and the corresponding antagonists should be exercised by petrissage and tapotement. The nerves to the relaxed muscles also should be stimulated by petrissage, but it must be kept in mind that too strong stimulation may be of no value or it may even be harmful (in this respect there being a condition like that of Pflueger's law), since strong stimuli may not only decrease but also temporarily abolish nerve irritability." (Oden, 12.)

In short, attention should be directed (1) to increase the tone and the strength of those muscles that are flaccid and atrophied and (2) to reduce the contracture state in the muscles that are tightly contracted (tonus is shortening). It is not the quantity of the massage which is of benefit; it is the quality.

Exercises. It is advisable to lay special emphasis on the following points: (1) That it is not wise to prescribe exercises in a general way and leave the parents or the masseuse to attend to the details; (2) that the physician must study the case thoroughly to know to what extent the nerves and muscles are affected; (3) that he must give the exact details of the exercises. Indicate, therefore, the muscles to be exercised, the character of the exercises, the number of times that the particular movements are to be performed at each session as well as the number of sessions each day.

When to begin the exercises. Opinions vary on this point, ranging from one to six weeks. H. Oppenheim (3), in his excellent book on nervous diseases, discourages early movements, stating that there can be no question that these attempts at movement encourage the development of contractures. Hence even if the leg has regained a certain degree of mobility, the patient should still spend a greater portion of the day in bed. In reality no specified time can be given, each case being considered individually in relation to its sensitiveness, the amount and character of the contractures. During the first week, light passive exercises for the fingers, hands, toes and feet are used. They must be performed slowly and easily. In the second week, the

forearm and leg likewise may receive passive motion.

In our cases we began massage and exercises in the third week after the operation, as we were anxious to see the relaxation of the muscles and the improvements from the operation. To go into details about the exercises is not within the scope of this paper. We made use of symmetrical exercises, i.e., where the good limb performs at the same time the same motions that are expected from the affected limb (taking advantage of synkinesia, i.e., on moving one limb the other may move). In the beginning the exercises were given from 5 to 10 minutes and then for 15 minutes twice a day. By consulting Frenkel's book on tabes one arrives at an understanding of how to teach these patients the proper way of walking, sitting down and getting up. The importance of exercise in these old patients may be measured by its beneficial results. (1) It avoids the effects of general idleness; (2) it improves the paralyzed muscles; (3) it prevents arthritis of the joints so common in these cases; (4) it lowers blood pressure; (5) it stimulates endocrine secretion.

Electrical treatment. As in all forms of nervous diseases, electricity has its advocates. Some advise galvanic, others faradic, while some pay tribute to sinusoidal currents. We do not care at present to discuss the merits of each of these forms of electricity. The physician can use the form he has most faith in or the form most available. It is to be understood that electricity indiscriminately used is capable of increasing the hypertonus which it is intended to combat.

Thus far I have emphasized the need of prevention of contractures. It will be worth while to say a few words about curing the contractures if present at the time of consulting the physician. The details of these methods can be found in any orthopedic book.

For the elbow-joint, gradual stretching by applying a plaster cast and wedging it or reapplying new casts every two or three weeks as the spasm is relaxed. The same principle holds true for the knee-joint. For the wrist and fingers one can make use of the Jones method of treatment of Volkmann's contractures (10, 11, and 15). As mentioned before, the fingers can be straightened only when the wrist is flexed. Apply therefore a brace (Jones' "cock up" splint or brace advocated by Taylor, Fig. 4) or a plaster-of-Paris splint with the wrist completely flexed and the fingers straight.

Method of application of Jones' splint. (1) An assistant passively flexes the wrist to allow the fingers to extend and each finger is separately strapped to a little gutter-shaped splint, so that it cannot curl up. (2) A day or two later, or in milder cases at the same sitting, the metacarpophalangeal range is increased and the palm and splinted fingers are bandaged to a flat metal splint. The whole hand and the fingers are now rigidly fixed with the wrist flexed. (3) The wrist is now from day to day extended a little and fixed. This is continued until the wrist is hyperextended. The hyperextension of the wrist and fingers is maintained for a long time. Keep the splint for a long time until the chances of recurrence disappear.

For the lower extremity, it is advisable to overcome at first the resistant contraction of the knee (the cutting of the tendo achillis for the drop foot before the knee is straight would induce a calcaneous deformity of the foot). One may apply a plaster splint and extend the knee gradually. An open tenotomy of the hamstrings may be indicated. Precaution must be used in straightening a joint that was in contractured flexion for a long time not to rupture the shortened vessels. One must also remember that arteriosclerosis is usually the underlying cause of apoplexy and sudden stretching may cause rupture of the artery. Even in a case of 21 years' duration we were able to correct a markedly contracted knee by gradual stretching.

At the time of straightening the knee, the foot is put at right angles with the leg. Later on the tendo achillis may be cut and the foot put up in overcorrection. The varus position is also corrected by tenotomy of the plantar fascia and forcible correction. When the plaster is removed, a brace can easily be applied. Sometimes tendon transplantation is advisable.

CONCLUSION AND SUMMARY

Our studies lead us to conclude that:

1. Early operation within two to four weeks, or even after a much longer period, may be indicated in hemiplegia—

a. Where the intracranial pressure threatens medullary strangulation, no matter what the site or nature of the lesion;

b. In extradural hæmorrhage, with or without intradural hæmorrhage or cerebral contusion, where cerebral compression threatens life or permanent disability;

c. In intradural hæmorrhage of traumatic or spontaneous origin where cerebral compression threatens life or permanent disability.

d. In intracerebral hæmorrhage where focal compression threatens life or permanent disability.

2. A subtemporal decompression and evacuation of the clot is a simple procedure and should be used in every case of fresh hemiplegia where the above-mentioned indications are present.

3. If the patient be unconscious, an anæsthetic need not be used, as the shock of the operation is small.

4. Even in old cases of hemiplegia decompression is of benefit.

5. Decompression should be used even in cases due to embolism or thrombosis.

6. The deformities and contractures of hemiplegia can be prevented.

7. Patients with hemiplegia should be put in the same category as anterior poliomyelitis and receive proper orthopedic treatments from the beginning.

8. Plaster splints should be applied immediately to prevent contractures.

9. Massage and exercises are indicated and should be used intelligently.

10. Proper use of the limbs should be shown to the patients and encouraged.

11. In old and neglected cases deformities should be corrected and recurrences prevented.

REPORT OF CASES

CASE 1. Extradural hæmorrhage; right hemiplegia, and aphasia: Operation; recovery with full function. H. R. U., age 39, on night of June 1, 1916, fell from a street car, striking on left parietal region of head. Primary unconsciousness was followed by lucidity. Right hemiplegia with motor aphasia and a trace of left external strabismus were present. June 2, a.m., the patient was in coma; blood pressure, 150–90; pulse, 44; respiration, 28; average ratio of inspiration to expiration in seconds, 1:1.5 with no pause between; expiratory phase enhanced, i.e., slightly forced and puffy and prolonged at expense of period of rest.

Physical examination. Motor. Right arm and leg motionless; eyeballs moved independently and showed simultaneous divergence; movements of the left eye restricted compared with right. *Sensory.* Responds to prick, pinching and squeezing all over trunk, limbs and face. *Reflexes.* Epigastric, abdominal and cremasteric, absent on right; knee-jerks equally exaggerated on both sides; ankle clonus present on both sides but more marked on right; Oppenheim and Gordon showed extensor response on both sides, more marked on right. *Pupils.* Almost pin point, left larger; fundus oculi; outlines of left disc slightly blurred, vessels fuller than on right.

Diagnosis. Extradural hæmorrhage; operation performed by A. S. Taylor 12 hours after injury. No anæsthetic. During the trephining the patient breathed forcibly and rapidly, making on inspiration and more especially on expiration a noise resembling steam rushing from a pipe. This ceased the moment the disc of bone was removed, as the clot began to extrude but showed signs of returning when twinges of pain began to be felt. When the opening in the skull had been enlarged, a large clot was removed, the patient having sunk into a natural sleep, pulse 72; respiration 32, with normal ratio of inspiration, expiration and pause.

Recovery was slow but complete with a gradual return of function. At first there was disorientation and sensory as well as motor aphasia. Gradually the patient learned to appreciate his surroundings and to speak simple sentences, to understand spoken and written language. No orthopedic treatments were used in this case.

On September 12 (three and a half months later), all he had gained in the way of speech, etc., was suddenly lost through psychic shock when the patient was told that his child had an attack of infantile paralysis, an epidemic which was then prevalent. For 7 days he could not understand written or spoken language and could not speak. During this time he was confined to bed. On May 30, 1917, without apparent cause, he had twelve convulsions lasting about 10 minutes, which began on his right side and extended to the whole body, consciousness not being lost (wife's report).

On February 16, 1918 (one and a half years later), his mental and physical condition was excellent. There was a slight constriction of the visual fields on the right side. The patient was engaged at his regular occupation as buyer for an export house. A later report informs us that in the fall of 1918, he had convulsions again.

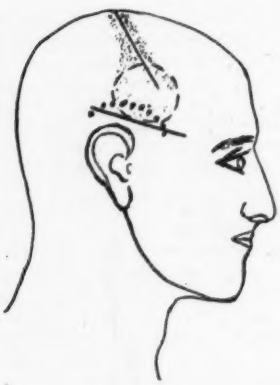

Fig. 1.

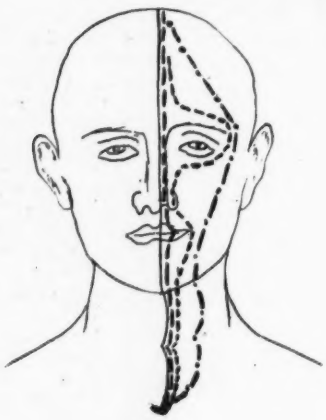

Fig. 2.

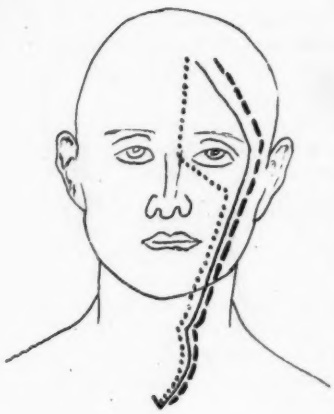

Fig. 3.

Fig. 1. Case 4. Showing location of the cyst. Solid lines fissures of Rolando and Sylvius. Dotted line, operative incision. Line of dashes, site of cyst following hæmorrhage which caused left hemiplegia. Shaded area, Cortex softened and atrophied.

Fig. 2. Case 5. Working from the outer toward the median aspect of the face, the lines represent the boundary of preserved sensibility as follows: Dots and dashes, prick for algesimeter at 3 grams pressure. Outer line of dashes, pressure-touch for æsthesiometer weighted with 40 grams. Inner line of dashes, pressure-touch for unweighted æsthesiometer. Solid line, touch, for heavier von Frey tactile hairs; sensibility for the lightest hairs being absent to the middle line.

Fig. 3. Case 5. *At solid line*, 55° C. began to cause discomfort, the nature of the stimulus being poorly appreciated. *At line of dashes*, ice in tube began to be felt as electricity. *At line of dots*, ice in tube was appreciated as cold at times. Over the remainder of the left half of the body sensibility was absent for superficial and deep critical stimuli and for superficial affective stimuli, being preserved with overreaction, etc., for deep affective stimuli.

Case 2. Extradural hæmorrhage on left side of brain with signs of contusions and *left* hemiplegia: Hemiplegic signs and sequence of phenomena of irritation and inhibition pointed to lesion on *right* side, whereas the external marks of violence and ocular phenomena pointed to a left-sided lesion; both sides trephined; collapse; resuscitation; subsequent death.

L. H., male, 15 years of age, thrown from feet by coasting sled about 3 a.m., December 27, 1917. He was unconscious at first, later conscious. At 5 p.m., he regained consciousness; was pale and chilly; and still in shock; pulse 84, blood pressure 118–82; respiration 30; plantar reflex; flexor response on both sides with an occasional extensor response; left pupil smaller than right; both reacted to light. Subconjunctival ecchymosis of left eye and contusion of left side of face and head. December 28, 11 a.m., the patient was in heavy stupor, with marked restlessness and tendency to roll to right on face; pulse 60; respiration 28 with normal ratio and rhythm; blood pressure 124–64. Impaired motor power on left side. *Reflexes.* Epigastric and abdominal absent on both sides; cremasteric easily fatigued, especially on left; knee and ankle jerks exaggerated on left; ankle clonus present on left; plantar and Oppenheim gave extensor response on right and left as did the Gordon, the latter giving, in addition from both sides, a readily elicited crossed extensor response in the great toe. This possibly meant commencing paralysis of Sherrington's prespinal center with reversion to the simpler, flexion type of reflex. Fundi: Disc outline slightly obscured with vessels full and tortuous, both signs being more marked on left. Pupils: Left, 5 millimeters; right, 4 millimeters. The reflexes and loss of motor power pointed to a right-sided lesion, whereas the ocular phenomena and the external evidences of injury pointed to a left-sided lesion. (Possibly this was a case in which the pyramidal tracts did not decussate.)

About noon on December 27, spasms appeared in the left arm extending to the whole of the left side and then over the whole body. Convulsion came after convulsion, the whole body later on going into a state of tonic rigidity from time to time with the exception of the left arm, which now remained flaccid. At 6 p.m. the pulse was 32; respiration 36; the expiratory phase being accentuated and prolonged; no pause after expiration; phasic periods suggesting the Cheyne-Stokes type. Fundi: Disc outlines more blurred than at 11 a.m., vessels fuller and non-tortuous. All phenomena more marked in left eye. Pupils: Both moderately dilated, left larger; no reaction to light either in preliminary dilatation or in constriction.

Operation performed by Dr. Louis Marton at 6 p.m. on December 28, 1917; right side of skull trephined; no evidence of lesion; left side then trephined but patient stopped breathing before the

skull had been opened. Resuscitation by Laborde and modified Schaefer methods of artificial respiration; operation continued; extradural clot found; symptoms improved temporarily but patient died about midnight.

CASE 3. Intradural hæmorrhage with hemiparesis and lucid interval suggesting extradural hæmorrhage; operation; recovery.

V. G., male. On January 14, 1918, while coasting, fell over embankment, striking on head; primary unconsciousness; projectile vomiting; blood in vomitus. The patient was conscious on admission; pulse 72; respiration 32, with slightly phasic variations. The patient lies on his back, with legs drawn up and somewhat stiffened. *Motor.* Flattened facial expression on left; has little or no power in left arm; seems to move both feet equally well. *Sensory.* Sensibility for sharpness (pin prick) impaired on left (face, arm, hand and trunk); no apparent impairment in legs or feet. *Reflexes.* Epigastric and abdominal, absent on both sides. Cremasteric, present and equal; left knee-jerk exaggerated; plantar gave extensor response in both feet, more marked on left. Eyes: Persistently turned to right with slow jerking movement to left which however never carried the eyes beyond the primary position. Tendency of trunk to rotation along axis to right so that the right side was undermost in bed. The pupils exhibited remarkable changes. At first they were dilated and equal, right was later larger than left (6 and 3 millimeters); still later, when the patient went into coma, both pupils became small but the right was larger (4 and 2 millimeters); even now there were slight hippus movements in the right and marked primary dilatation to light in both eyes with prompt recoil into constriction. At this point the pupils became smaller and the primary dilatation to light gradually disappeared. At times even now the pupils showed rhythmic alternations in dilatation and constriction, the patient remaining in coma. The pupillary measurements were: right, 4 millimeters; left, 3.5 millimeters. Extreme difficulty was encountered in attempting to study the fundi. All that could be definitely ascertained was that there was vascular fullness. At this time the pulse was 60, with the respiration showing slight phasic variations. There was no marked rise of blood pressure; spinal fluid contained blood. The patient showed some signs of improvement, which, however, were temporary.

Operation by Dr. A. H. Harrigan. Osteoplastic flap on right side. A few small extradural and one large intradural clot were found. The patient was in a precarious condition from 24 to 48 hours after the operation but made a good and complete recovery. No orthopedic methods were used.

CASE 4. Spontaneous intradural hæmorrhage (thrombosis?) with cystic formation causing left hemiplegia; operation 20 months after onset; marked relaxation of spasticity after operation; orthopedic treatments were of great help.

Fig. 4. Case 4. Showing the braces applied to the paralyzed limbs and the good position obtained. Note Jones' brace for the hand.

V. O'S., female, age 48; apoplectic attack during pneumonia in June, 1916, causing left hemiplegia. Examination on February 13, 1918, showed: *Motor.* Marked spasticity in left arm and leg with contractures (fingers closed tightly in the palm), foot in the position of talipes equinus. *Sensory.* Impairment for superficial (light touch, sharpness, etc.) as well as for deep pressure, touch, compass points consecutively applied, etc. *Critical stimuli.* No appreciable impairment for affective stimuli (pressure, pain, etc.) was observed in left calf. The defect in sensibility was more marked in the hand than in the foot.

Operation by Dr. Taylor, February 20, 1918. A large cyst containing fluid under pressure was found at the site indicated (Fig. 1). Running up from the cyst, which was at the site of the frontoparietal operculum was an area of softened brain tissue, fluctuating and easily compressible. This was probably the lesion which gave origin to this cyst; it was originally intracerebral, the extravasated blood ultimately finding its way to the surface of the brain. Immediately after the operation the left hand and foot were found relaxed. This lasted

Fig. 5. Case 6. L. P. showing the patient while walking. Note the good condition of the muscles. All pictures of Case 6 were taken in June, 1918.

for a week when the contracture deformities began to reappear. Plaster splints were then applied by Dr. Boorstein to keep the hand and foot in the position desired. This might have been applied with better results immediately after the operation, but we were desirous of seeing when contractures would recur.[1] The case is not an instance of early operative treatment of hemiplegia but it illustrates the early postoperative orthopedic measures and shows the improvement obtained from the decompression even after such a long delay.

Treatments began ten days after the operation. The plaster casts were left on for two weeks, then a brace was used (Fig. 4). At present, 6 months after the operation the patient can walk much better and has fair use of the limbs.

CASE 5. Spontaneous intracerebral hæmorrhage in the vicinity of the internal capsule and ventrolateral aspect of the thalamus, causing hemiplegia and the thalamic syndrome; markedly heightened arterial and intracranial pressure in association

[1] All the patients operated on after this case had application of plaster splints while still under anæsthesia.

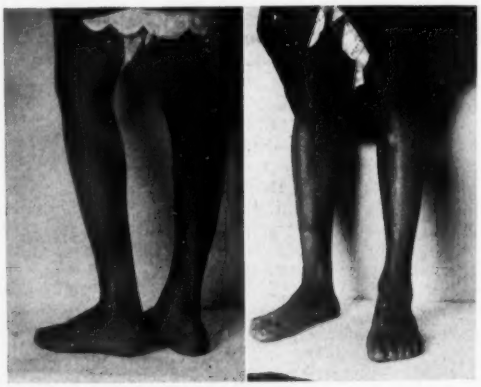

Fig. 6. Case 6. Posterior view of the patient showing the proper gait. Slight contraction of left tendo Achillis.

Fig. 7. Case 6. Anterior view, showing ability to bring the paralyzed limb into good position.

with arteriosclerosis and chronic nephritis; operation; clot and serum evacuated; improvement.

B. McL., age 58, an apoplectic stroke early in March, 1916. Examination four weeks after onset showed left flaccid hemiplegia with sensory findings suggesting lesion of the ventrolateral aspect of the thalamus. Little or no overreaction for affective stimulation at this time.

Examination on April 12, 1916: Pulse 100, respiration 24, blood pressure 180–150; blood Wassermann, negative; spinal fluid under pressure, at first clear but later tinged with blood and containing epithelial cells in addition to white and red blood-cells; urine: specific gravity, 1013, trace of albumin with some hyaline and granular casts. Neurological examination: *Motor*. Left hemiplegia of flaccid type. *Sensory*. (1) Spontaneous, none. (2) Actual, sensibility over left side of face and body as shown in Figs. 2 and 3. There is an appreciable loss of sense of taste and smell; hearing is impaired slightly on right side from injury in childhood. Vision is poor; there is a left homonymous hemianopsia (rough clinical tests). The right pupil is larger than the left (5:7.5 millimeters). Both pupils reacted to accommodation but not to moderate illumination. The fundi showed blurred discs with vessels full and tortuous. *Reflexes*. The left knee-jerk was just beginning to show a relative hyperactivity. (On April 3, this jerk was hypo-active as compared with the right.) Plantar reflex showed extensor response on left. On April 15, 1916, a right subtemporal decompression operation was performed by Dr. Taylor. When the dura was opened, the brain substance bulged into the opening. A needle was passed into the inferior horn of the lateral ventricle and clear fluid spurted several inches into the air. The needle was next passed toward the outer aspect of the internal capsule and some dark clots and yellow serum extruded. The operation

Fig. 8. Case 6. Ability to flex the elbow.

Fig. 9. Case 6. Showing the fair condition of the skin but unable to extend the fingers completely.

Fig. 10. Case 6. Anterior surface of the hand showing the absence of atrophy and the contractures. All pictures of Case 6 were taken in June, 1918.

was performed under local anæsthesia which was used only for the incision into the scalp. Practically no pain was experienced except when the periosteum and dura were cut or pinched. Immediately after operation the threshold for affective stimulation in the arm and hand was exactly the same as it had been just before the operation but the pupils had become smaller, the right being larger than left (3:3.75 millimeters). A good recovery was made from the operation but the conditions back of the cerebral lesion were not appreciably helped. The blood pressure at times was very high, e.g., 200 millimeters mercury diastolic, but the brain and optic nerve functions improved in spite of this and the generally poor condition of the patient. A soft swelling as large as a hen's egg soon made its appearance at the site of the operation. This gave the patient no trouble and undoubtedly had much to do with the improvement noted in the patient's vision and mentality.

In the few months that the patient was under observation there was some improvement in the hemiplegia. The thalamic lesion became stationary and gave opportunity for detailed studies which are reported elsewhere. No orthopedic treatments were used on this patient. In July the patient left the hospital and passed out of observation.

Case 6. Intracerebral vascular lesion in vicinity of internal capsule causing left hemiplegia, hemianæsthesia, etc.; operation; lesion located in region of internal capsule and actually seen by means of the endoscope

L. P., female, age 17, colored, born in United States. In July, 1916, was hit on the right side of the head by lid of ice box; was not rendered unconscious but afterward was subject to throbbing headaches and the hot weather seemed to affect the head. On October 6, 1916, in the middle of the day, there was a sudden onset. The first signs were in the right cheek and hand. A moment later power was lost in the left leg. The patient then became unconscious and remained so for three hours. When the patient first came under observation, there was marked spasticity of the left upper and lower extremities.

On February 8, 1917 (four months after onset), Dr. Taylor opened the skull. The cortex looked normal but on passing in an exploratory needle a little over 1 centimeter deep, marked resistance was felt. On pushing the needle still farther, a small amount of fluid came through the needle; it was denser than ventricular fluid and slightly yellowish in color. On pushing the needle still further the ventricle was entered and some normal ventricular fluid came out. It seemed possible that an endoscope through which there was illumination might give some information about this deep lesion, so one was inserted and some resistance was encountered. When the light was turned on a perfectly white avascular area of tissue was seen. On withdrawing the endoscope, the line of demarcation was visible between the avascular tissue and the normal pink brain substance. Evidently this white area represented some form of induration involving the capsule which caused the marked spasticity.

Since operation the patient has done well and has gained a fair amount of function, the most noticeable feature being the freedom of movement of the limbs although the finer movements remain markedly impaired. Massage was started three months after the operation. No plaster or brace was used to prevent contractures, as we believed like many others that massage was enough to prevent these. One year after operation the hand began to contract and the tendo achillis shortened giving her a ten-

dency to dropped foot. A Jones "cock up" splint was applied to the hand. A special strap was applied to the foot. These were left on for a long time, for 24 hours a day and later on only for the night. The spasm was finally overcome and no recurrence occurred. (From this time on our supports were applied early.)

Examination on January 11, 1918, showed: *Motor.* Left hemiparesis with slight atrophy of upper and lower limbs; gross movements of both limbs free but finer movements of hand markedly impaired; athetoid movements of left arm and leg (see Figs. 5 to 10). *Sensory.* (1) Spontaneous, none; but patient has a feeling of pins and needles when massaged (this disappeared later on). (2) Actual (a) superficial critical sensibility (light touch and its localization, compass points simultaneously, sharpness, and the specific elements of heat and cold ranging about the neutral point of skin temperature) impaired; (b) deep critical sensibility (pressure, touch and its localization, compass points consecutively applied; posture and passive movements; some elements of vibration, size, shape, form, weight, etc.) impaired; (c) superficial affective sensibility (prick, gross heat and cold in Ag tubes lightly and momentarily applied) impaired, with no evidence of true overreaction; (d) deep affective sensibility (pressure-pain, some elements of vibration, gross heat and cold in prolonged, massive application) preserved, with no trace of abnormal overreaction. *Reflexes.* Superficial, impaired; deep, exaggerated. *Mentality.* Excellent. Bright, alert subject. There was no abnormality. (The patient had antiluetic treatments for months before operation but without apparent benefit. Luetic tests of the blood and spinal fluid were at all times negative.)

Examination in December, 1918, showed some improvement in motor sensory function. Fine movements of the hand still markedly defective, critical sensibility still markedly impaired. Affective sensibility slightly impaired but no true overreaction present. The left arm is smaller and shorter than the right. The patient walks fairly well and can use a typewriter.

Anatomical diagnosis. There is a lesion of the internal capsule, presumably hæmorrhage; only etiological factor ascertainable was the injury to the skull. The case is interesting from the physiological standpoint and furnishes a good illustration of the amount of function that is possible under surgical and orthopedic treatments, even where there is manifestly a serious extensive lesion of the internal capsule. It also illustrates that deformities should be prevented, as they may recur even one year after the operation.

CASE 7. Intracranial lesion (thrombus in vicinity of internal capsule) causing right hemiplegia and motor aphasia; operation; no evidence of clot or of increased intracranial pressure; recovery with decided improvement in speech and motor power.

B. B., male, aged 55; had apopleptic stroke in March, 1916; comparatively slow onset; consciousness lost; no convulsions. When seen, he had typical right hemiplegia with motor aphasia. Repeated efforts to determine whether the sensory mechanisms were involved were fruitless (probably on account of his mental and aphasic condition). No clinical or neurological evidence of lues or of a general increase of intracranial pressure. The urine showed no apparent pathological changes. Five weeks after onset there being no apparent improvement mental or physical, it was decided to operate. On April 5, 1916, Dr. Taylor performed a left subtemporal decompression without anæsthesia. Only a slight murkiness of the pia was found, chiefly along the blood-vessels of the lower precerebral and postcerebral areas. The brain was carefully explored but no evidence was found of clot or of increased intraventricular tension. There was degeneration of cortex and subcortical tissues of the tip of temporosphenoidal lobe and of the lower motor area suggestive of infarction. The patient made a good recovery from the operation. Plaster casts were applied to the paralyzed extremities two weeks after the operation. One week later the patient was encouraged to walk. Massage was given three weeks after the operation.

On March 1, 1916, examination showed: An intelligent, well-nourished man who in spite of the manifest disabilities of his old hemiplegia, walked very well. Speech had improved markedly though it was still slightly defective at times. The power to relax the quadriceps extensor femoris was a feature worthy of notice. This is probably to be attributed to the early orthopedic treatment and it is the chief reason perhaps why there has been such a marked improvement in gait. The hand is still kept on a Jones splint as there is still a tendency for the contractures to recur. *Sensory.* Impairment for light touch and its localization, sharpness, etc., on right arm and leg; smell and taste preserved but perhaps slightly impaired on right for sweet.

Whether operation benefited this patient cannot be answered positively but personally one of us (Byrne) is inclined to think it did. There are other ways in which operative interference may be of benefit in these cases besides the immediate removal of a clot or a collection of serum. Even in cases which present no gross evidence of a general increase of intracranial tension it is possible that a mere decompressive operation may tend to re-establish the circulation of the blood and cerebrospinal fluid in the vicinity of areas subjected to focal circulatory disturbances as the result of thrombus, embolus, hæmorrhage or other intracerebral lesion. The sudden appearance of improvement right after the operation certainly seems more than a mere coincidence.

NOTE.—We had a few cases with hemiplegia due to nephritis and to cerebrospinal lues where no decompressive operations were performed, only orthopedic treatments being used. They also showed marked improvement in the power and gait. All contractures were prevented. The improvements, however, in our opinion are slower than with decompression.

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RADICAL RESECTION OF THE ŒSOPHAGUS FOR CARCINOMA

BY DR. ADRIAN J. BENGOLEA, BUENOS AIRES, ARGENTINE

FOLLOWING the suggestion of Willy Meyer that surgeons doing thoracic surgery report their experiences whether favorable or unfavorable, I wish to submit the history of a case which I believe is the first case of resection of the œsophagus in the Argentine literature. With the exception of the case of Torek reported in 1913, our case has survived longer than any other so far reported and our patient was in very serious condition at the time of operation.

We all know that surgery upon the thoracic organs has been the subject of much thought and although progress has been made with regard to surgery upon some of the organs of the thorax, surgery of the œsophagus, because of its anatomical situation and its characteristics, still presents many difficulties; in fact for many years the opinion prevailed that the œsophagus was surgically inaccessible. However, I believe that surgery of the œsophagus is in full development and that the means of reaching the œsophagus has been definitely established. I believe that the method of administering the anæsthesia has been so perfected that the danger from pneumothorax is nil, and I believe that at the present time, contrary to what statisticians may think, exploratory examinations should be made, for it is only in this way that we can discover cases which may lead to failure, and acquire a greater knowledge in regard to treating this condition.

The case I am about to report entered the Rivadavia Hospital on the service of Dr. A. Zabala, who very courteously referred the patient to me for operation.

The patient, a woman 37 years of age, in a very poorly nourished state, complained of an œsophageal affection, which had been troubling her for 16 months. The lumen of the œsophagus had become so narrow that for 20 days the patient had not been able to take liquids of any kind. Her weight at the

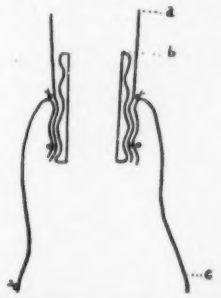


Fig. 1. Œsophagogastrostomy: *a*, œsophagus; *b*, bobbin; *c*, stomach; *d*, diaphragm.

Fig. 2. Microscopical findings in tumor removed from author's case.

time of entering the hospital was 77 pounds. The Wassermann was negative. Examination with a Bruning œsophagoscope revealed a tumor, which was located 33 centimeters from the dental arch and which bled easily. X-ray examination showed that opaque meals did not pass the tumor. With these findings a diagnosis of carcinoma of the œsophagus was made and it was decided to operate, using the following technique.

A Torek's incision was made beginning at the left seventh intercostal space, extending upward over four ribs which were divided with a Doyen rib shears between their angles and the spine. The blood-vessels were exposed and ligated. We opened the pleural cavity and found the lung well expanded with some thin adhesions starting from the base of the lung to the diaphragmatic pleura. The adhesions were easily separated by diminishing the pressure of anæsthesia, and the lung was carefully protected with a silk compress. On exposing the œsophagus we found in its lower portion, a hard, fixed tumor 6 centimeters in length, the lower part of which ended 2 centimeters from the diaphragmatic hiatus. We introduced the scissors through the diaphragmatic opening and incised following the direction of the fibers. Once in the abdominal cavity we pulled the stomach toward the thorax In this way it was possible to judge as to the advisability of resecting the tumor and as well as to the possibility of reconstructing its lumen; œsophagogastrostomy. The pneumogastric nerve, the azygos vein, and the aorta were gently pushed aside, thus freeing the œsophagus to as great an extent as possible. The œsophageal resection was begun at the cardia, following the usual technique for intestinal resection. The stump was protected

Fig. 3. Patient 20 days after operation, showing line of incision and drainage opening.

with gauze. The stomach stump was closed by Lembert continuous suture. The moment the tumor was excised, extra care in asepsis was exercised. On removal of the tumor a wooden bobbin was placed in the œsophageal opening and fixed by means of a catgut purse-string suture. The portion of the stomach pulled up into the thoracic cavity was opened at the point of least traction and as near as possible to the greater curvature, and was then placed in the œsophagus in which the wooden bobbin had already been placed. By purse-string suture, as shown in Figure 1, the stomach was fixed to the lower groove of the wooden bobbin. The anastomosis was later strengthened by continuous gastro-œsophageal suture which protected and invaginated the œsophageal stump. The diaphragmatic wound was closed and the stomach fixed by means of interrupted suture to the diaphragmatic muscle. The thoracic wound was closed after free incision in the tenth intercostal space for drainage of the pleural cavity in accordance with Kenyon's technique.

During the operation which lasted two and a half hours, caffeine, strychnine and salt solution were injected. The pulse at times was as low as 60; at the end of operation it was 120.

Intratracheal insufflation anæsthesia with the Janeway apparatus was very ably administered by Dr. Rodriguez Egana. The patient slept peacefully during three hours.

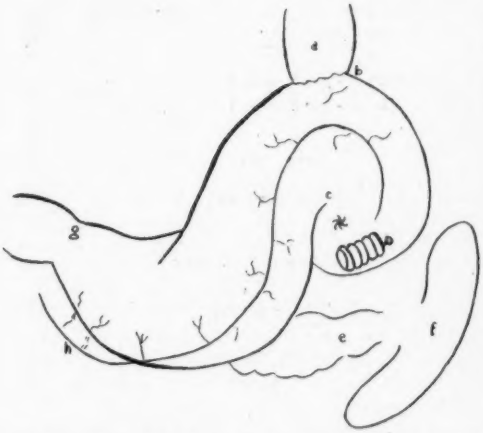


Fig. 3. Autopsy findings showing the stomach disposition and the bobbin displaced from the anastomosis. *a*, Œsophagus; *b*, anastomosis; *c*, cardia; *d*, bobbin; *e*, spleen; *f*, pancreas; *g*, duodenum; *h*, gastro-epiploic artery.

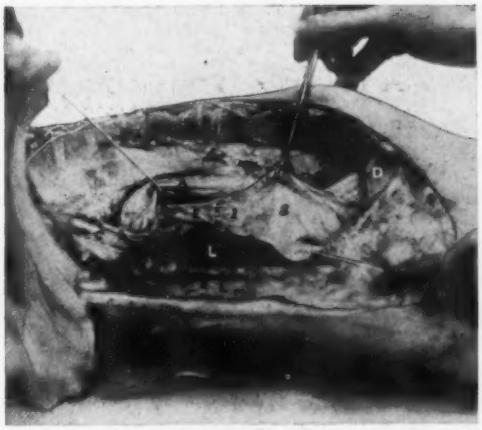


Fig. 4. Autopsy findings, showing chest wall removed and the lungs pulled forward exposing the organs of the mediastinum and the anastomosis. *s*, Stomach; *l*, lung; *œ*, œsophagus; *a*, aorta; *c*, carotid; *d*, diaphragm; *i*, anastomosis.

For three days after operation Murphy proctoclysis was given by the drop method and heart stimulants were also given. Food was given per rectum. Considering the condition of the patient at the time of operation, there was no great shock, no dyspnœa, the pulse remained between 100 and 120 per minute. There was no vomiting. Food through the mouth was not given until the fourth day, at which time the patient took 200 grams of water in small amounts. On the fifth day milk, gruels, etc., were given. After this the patient was given soups, pastes, etc., without any inconvenience. On the sixth day the drainage was discontinued. On the seventh day the wound was in good condition and on the tenth day the sutures were taken out.

On the fifteenth day after operation, the patient presented a very grave general condition: Heart beats 140 per minute and there was evidence of a very large pleural effusion. The heart apex beat was on the right mammillary line. The drainage wound was reopened and about 3 liters of a serosanguinolent fluid were evacuated. New drainage was established. At the end of 10 days the fluid was of a purulent nature. Nevertheless the patient fed herself and she experienced no difficulty in swallowing.

A few days before death, there was extreme œdema of the extremities; the patient was in very bad general condition, but her appetite was still good. She died 37 days after operation.

Autopsy. The thoracic cavity was opened through the wound of operation. There was found 150 grams of a purulent fluid and some membranous exudate within the pleural cavity. The pleural membrane was thickened throughout and an inflammatory exudate was present. The lung was very much retracted, shrunken, and was fixed anteriorly to the pleura. The œsophagogastrostomy was isolated from the general pleural cavity by a portion of the base of the lung, and this adhesion was probably the cause of the anastomosis not closing absolutely. Thus the lung played a very important rôle in protecting the general pleural cavity from the possibility of communicating with the œsophagogastric contents.

DEPARTMENT OF TECHNIQUE

A TECHNIQUE FOR NEURORRHAPHY

By Major KENNETH BULKLEY, M.C., U.S.A.
Formerly Chief of Surgical Service, American Red Cross Military Hospital No. 2, Paris, France

THE technique of nerve suture about to be described was devised by Colonel Joseph A. Blake, who first used it in the care of French wounded during the winter of 1914-1915. As neither the records of about 15 patients thus operated by him at Hopital Militaire V.R.76 at Ris-Orangis nor the records of about 20 cases operated upon subsequently by the writer by the same technique at American Red Cross Military Hospital No. 2, Paris, France, are available, no detail case histories will be attempted. The procedure was devised for and largely used on cases of musculospiral nerve division in association with compound fractures of the humerus by gunfire.

Such cases fall into 2 groups. In the first group are included those patients who immediately after injury show symptoms of radial paralysis, due either to contusion or actual division of the nerve. For these the operation is not suited. The second group comprises those cases in whom the primary suture fails to give results, in whom no primary suture is attempted because of the character of the wound or the infection (the large majority), or those in whom during the process of bone repair a section of nerve becomes destroyed by inclusion in or by pressure from bony callus. For these cases, and particularly for those of the second subdivision of the group, the operation is eminently suited.

The principle of the procedure depends on the utilization of scar tissue for the release of tension on the actual line of nerve suture. In the majority of instances these cases cannot be operated upon until some time after injury, when bony repair is relatively complete and sinuses and concurrent infection have ceased to exist. By this time repair has also taken place in the nerve, but almost invariably with resulting bulbous ends and nonunion of nerve fibers. It is these apparently useless fibrous ends which prove valuable.

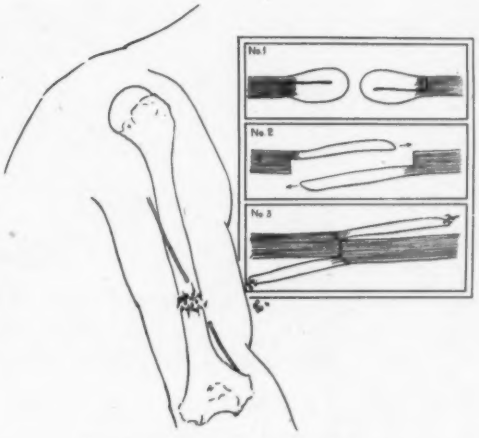
The illustration shows the method in which they are used. The distal extremity of the nerve is first isolated in normal tissue in the groove anterior to the supinator longus and dissected upward until the divided extremity is completely separated from the surrounding scar tissue, care being taken to preserve attached to the nerve as much of this scar tissue as possible. The proximal segment of the divided musculospiral is then sought and its end treated in a similar manner. It is essential that both ends of the nerve be sought primarily in an area free from scar tissue and that a quite considerable portion of them be freed. At times it will be most difficult to isolate the proximal segment. If not readily found, a useful procedure is to make a small incision posterior to be brachial artery just below the free border of the great pectoral, where the nerve will be found lying posterior to the ulna. Slight traction on it at this point will enable the operator to recognize it lower in the arm posterior or external to the humerus.

Before anastomosing, it is well to make a new muscle bed which will separate the site of anastomosis and the contiguous portion of the nerve from callus. This is readily done by turning over a "trap-door" of triceps muscle about a quarter inch in thickness, and holding it in place with a few plain gut sutures. The field is then prepared for the anastomosis proper.

At right angles to the long axis of the nerve and from opposite sides incisions are made almost but not quite through its thickness. These incisions should divide normal nerve tissue but should be placed as closely as possible to the scar tissue area (see No. 1 in illustration). From the depth of each of these incisions secondary incisions are made in the long axis of the nerve almost to the extremity of the scar tissue ends, and the flaps turned back (see No. 2 in illustration). In this way two long flaps of tough tissue well adherent to the sheath of the nerve are obtained for traction. The extremity of each of these is anchored, usually in neighboring scar tissue but occasionally in periosteum, in such a way that the divided nerve

fibers just meet without tension. We have used heavy chromic gut for these tension sutures. Care must be taken that the nerve is not rotated. Three very fine silk sutures including only the sheath of the nerve complete the neurorrhaphy. The suture line is covered with muscle and the wound closed without drainage. The elbow is immobilized for about two weeks in a posterior molded plaster splint at an angle of about 110 degrees.

Unfortunately we have seen the end-result of none of these cases, as military necessity has required their evacuation before functional return could be expected. But the early "results" seemed good. Of the cases done by the writer, in one instance only was it impossible by this method to approximate the divided ends. The loss in these cases exceeded six centimeters. A humeral resection only could have approximated them. In a second case rather severe infection followed operation. Here a bone abscess undiscovered by X-Ray was encountered and opened in the callus while freeing the nerve. Neurorrhaphy should have been abandoned but was not, with the result noted.



Drawing showing author's technique.

It is hoped that the procedure will be further used and end-results watched, as from a technical viewpoint it seems almost ideal.

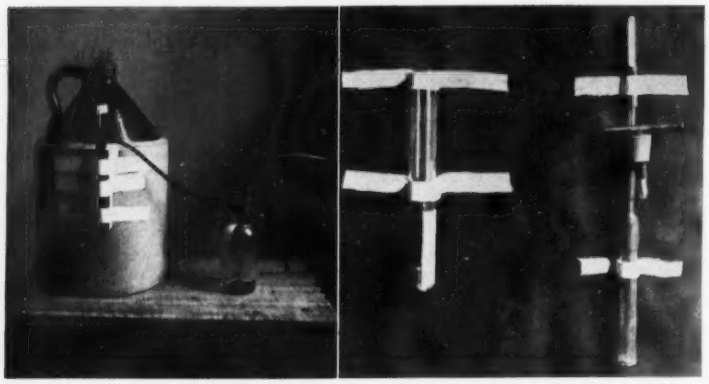
DRAINAGE IN EMPYEMA

By B. H. CAPLES, M.D., New York
Captain, Medical Corps, United States Army, U. S. General Hospital No. 14, Fort Oglethorpe, Georgia

NOT only in gunshot wounds, but in all operative procedures involving the thoracic cavity, pneumothorax constitutes a grave menace and one that should be remedied at the earliest possible moment. So in the drainage of empyema we are confronted by the problems not only of satisfactory drainage but of the prevention or the reduction of pneumothorax and the establishment of continuous negative pressure within the chest.

In cases where the pus has become localized and adhesions have formed, negative pressure, although indicated, is not so important as in the earlier cases where the danger of pneumothorax and subsequent lung collapse is very real.

Our operative procedure consists of a small intercostal incision, under novocaine, preferably in the eighth interspace, in the midscapular line and the insertion of a No. 22 French red rubber catheter just within the pleural cavity or in the costal gutter. Red rubber is used as black rubber tubes do not cast a satisfactory shadow in our X-ray plates. The catheter is held in place by means of a circular rubber flange that I am making from inner automobile tubing. The flange is one and a half inches in diameter and has a small hole punched in the center by means of a dental punch. The tip of a pair of thumb forceps is passed through this hole, the forceps gently opened, the tip of the catheter grasped and pulled through the opening as far as desired. Holes of varying sizes may be punched for different sized tubes. The flange should grip the tube firmly and but slightly occlude the lumen. Between the flange and the skin is placed a small pad of split gauze. Over the flange is placed another small split pad that is held in place by two strips of adhesive and the tube is firmly anchored to the patient's side by means of a strip of adhesive so that if any pull should occur on the tube it will be confined to that portion of it below the anchoring strip. If the tube fits the thoracic incision tightly, there will be no leakage but if there

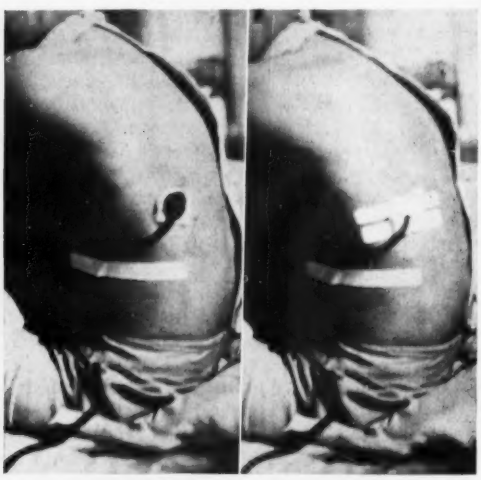


a (at left). Vacuum apparatus and collecting bottle. b. Manometer in detail.

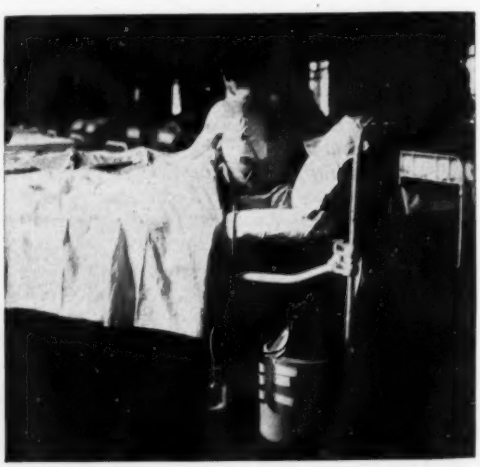
should be some it may be overcome by omitting the pad of gauze next to the skin and strapping the flange firmly around the opening. This, however, should not be continued more than two or three successive days as the skin becomes irritated. The negative pressure within the chest also assists by drawing the flange tightly against the skin, preventing leakage or the entrance of air.

The drainage apparatus, the description of which follows, I devised for suprapubic drainage on Dr. E. L. Keyes' service at Bellevue Hospital but which I found, with a few modifications, to be suited to the treatment of empyema.

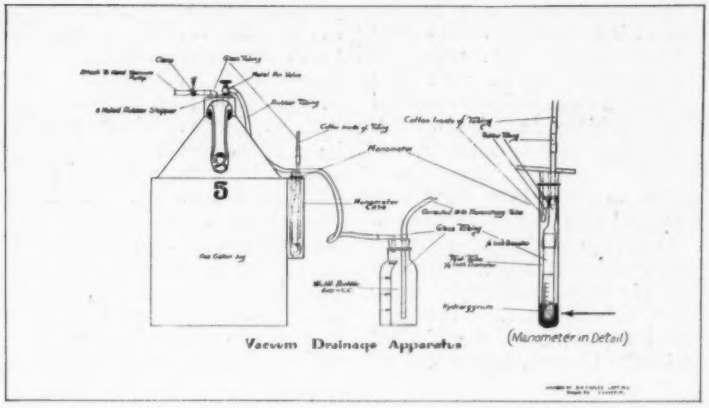
A five gallon jug is fitted with a two holed rubber stopper. In one hole is an L of glass tubing, the distal end of which is fitted with a short piece of stiff rubber tubing. The air is exhausted from the jug at this point by means of a large hand vacuum pump, one hundred strokes of which produce a vacuum capable of sustaining a column of mercury 500 millimeters in height. This rubber tubing is then clamped and the pump detached. The second hole of the stopper is fitted with a metal pin valve, obtained from an ethyl chloride tube, by which the rate of intake of air into the vacuum is regulated. This may be adjusted to a rapid or slow secretion of the fluid to be drained off. (In the absence of a valve a short piece of glass tubing with one



Rubber flange and type of dressing used.



Drainage apparatus in operation. This type of dressing was discarded for the one described and illustrated in present article.



Detailed drawing of apparatus. Arrow indicates height at which tube was filled with mercury.

end fused until only a minute opening remains, or a piece of thermometer tubing, either of which will admit approximately eighty bubbles of air per minute, at a negative pressure of 500 millimeters of mercury, may be used.) To the distal end of the valve is fitted a piece of rubber tubing that connects with one of the lateral arms of the metal T tube which in turn connects by means of its vertical arm with the manometer that will be described later. From the other lateral arm of the T tube, rubber tubing runs to the short arm of a 400 cubic centimeter Wolff bottle, that is used as a collecting bottle, and to the long arm of which is attached rubber tubing with a lumen of one-fourth inch, that connects with the thoracotomy tube.

The manometer consists of a test tube three-fourths of an inch in diameter and 6 inches long fitted with a two holed rubber stopper. Through one of these holes runs the short vertical arm of the metal T tube before mentioned, so that the negative pressure in the test tube is the same as that in the Wolff bottle and the chest cavity. Through the second hole of this rubber stopper runs a short piece of glass tubing, the lower end of which is fitted with a short piece of rubber tubing, which in turn is attached to a piece of glass tubing 4 inches long and 0.5 inch in diameter that reaches almost to the bottom of the test tube. The mercury is poured into the test tube to a height of about 1 inch immersing the lower portion of the inner tube. The manometer is tested by attaching a simple U tube manometer, graduated in millimeters, to the distal arm of the metal T tube. The valve is opened slightly and as the negative pressure increases the mercury rises both in the test tube and the U manometer. At the same time the mercury is being drawn down in the inner tube of the manometer and when it reaches a given point, air is drawn in through the glass tube, bubbles through the mercury and slightly relieves the negative pressure. At the same time the mercury ceases to rise in the U manometer and the reading is made. If more negative pressure be desired, more mercury is poured into the test tube. If less, mercury may be poured out. Over the outer end of the manometer tube, that opens to the open air and over the inner end of the vertical arm of the metal T tube are fitted short pieces of rubber tubing into the other ends of which are fitted short pieces of glass tubing filled with cotton. The ends of these cotton tubes are almost closed, so that the cotton will not be pushed down into the mercury. The object of these cotton tubes is to prevent the loss of mercury by the violent bubbling of air through it due to either excessive positive or negative pressure. The former takes place when fluid enters the collecting bottle rapidly as, for instance, during the return flow after flushing the cavity; the latter, if the valve be opened too widely. When positive pressure occurs the mercury is forced up into the inner tube of the manometer until it reaches a point at which air bubbles through it and escapes through the cotton tube, thus conserving the vacuum. The mercury acts as a liquid safety valve taking care automatically of excessive positive or negative pressure. On the outer surface of the test tube a scale in 5 milli-

meter intervals is marked on adhesive plaster, zero corresponding with the level of the mercury at atmospheric pressure. By this means the pressure at any given time may be read. The manometer is placed in a tube which is strapped by adhesive to the side of the jug, cotton being placed in the bottom of this tube to prevent breakage.

When starting the drainage in a given case the pin valve is opened until the negative pressure is sufficient to cause occasional slight bubbling of air through the mercury and is then left at that point. If the jug be pumped every 12 hours the valve will seldom need readjustment, and a negative pressure of any desired degree may be maintained for any length of time.

For the first 2 or 3 days following thoracotomy a negative pressure of from 10 to 20 millimeters has been found to be sufficient. Later, especially in cases of partial lung collapse, it may be increased gradually to 40 or 50 millimeters. Not only is the cavity drained but gradual distention of the lung follows. Even though the patient does not complain, the appearance of traces of blood in the discharge, unless due to the manipulation of the tube, is an indication for reducing the negative pressure.

This method has been adopted in our empyema wards and in a series of 31 cases thus treated, there has been but one death and that in a case of bilateral empyema that had been operated upon 4 weeks before the negative pressure apparatus was applied and who had developed pneumothorax and a general sepsis. Of the other cases 8 have completely healed and are up and about the wards and show no symptoms of a reaccumulation of fluid after a period of several weeks. Five have such small cavities and so little drainage that the negative pressure has been discontinued. The other 17 are draining satisfactorily, have no pneumothorax and are all in good condition. The average total period of drainage where negative pressure was used from the time of operation has been 6 weeks.

The apparatus is portable, easily made, the parts inexpensive, and it requires but a minimum of attention. Although by the use of Y tubes 2 or more cases may be drained by a single apparatus, it has been found more satisfactory to have a separate one for each patient.

A satisfactory vacuum pump may be made from a bicycle or automobile pump by simply reversing the plunger and valve.

Captain Frederick Knowles, assistant surgeon at U. S. General Hospital No. 8 informs me that he also is using this method of drainage in the treatment of empyema with good results.

At the present time, 8 weeks since the above was written, 26 of the above cases are healed, in good condition and show no signs of reaccumulation; 3 are so nearly well that negative pressure has been discontinued, and 1 has been transferred to another hospital.

I wish to acknowledge my indebtedness to Sarah O'Brien for her assistance in devising the drainage apparatus herein described.

GRAPHIC PRESENTATION OF FINGER DEFORMITIES[1]

By A. GOTTLIEB, M.D., San Francisco

In the treatment of joint deformities difficulties are frequently encountered in reporting the gain of motion. For the large joints, such as the knee and elbow, one of the many goniometers, fleximeters or any one of the many instruments which have been devised to register the amplitude of motion of joints, can be used with more or less accuracy. For the carpometacarpal, metacarpophalangeal and the interphalangeal joints these instruments do not give the desired satisfaction.

A very simple and useful method has occurred to me for the measurement of these small joints. This method requires neither expensive apparatus, nor is it exposed to the variations by the difference of applying the arms of the goniometer to the surfaces above or below the examined joints.

As soon as the patient presents himself for treatment, a "goniogram" is made which shows the active flexion and extension of each and every finger. The measurements are repeated about every 2 or 3 weeks and recorded on the chart, as demonstrated on Figures 1 and 2. The heavy lines on the figures represent the range of motion of the patient's normal finger of the other, well, hand. Should there be injury to both hands, a tracing can be made from the finger of an in-

[1] Read before the San Francisco County Medical Society, February 18, 1919.

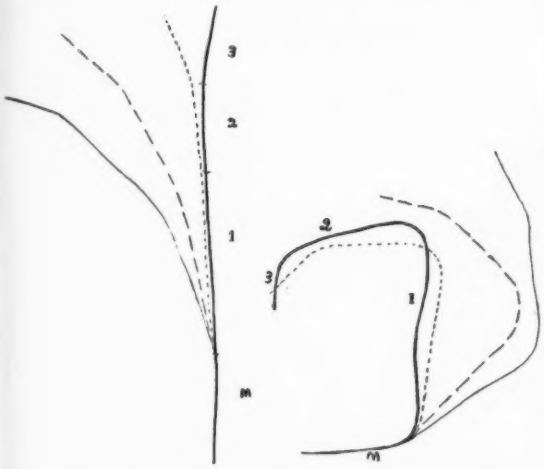


Fig. 1 (at left). Fourth finger in extension showing gradual improvement. –Normal contour of third finger in extension. —In extension June 8, 1918. – – –In extension June 28, 1918. . . . . In extension July 20, 1919.

Fig. 2. Fourth finger in flexion showing gradual improvement. –Normal contour of third finger of left-hand. —June 8 ,1918. – – –June 28, 1918. . . . .July 20, 1918.

1, First phalanx; *2*, second phalanx; *3*, third phalanx; *m*, metacarpal.

dividual of the same age and sex. The outlines of flexion and extension of the normal finger serve for the purpose of easy comparison with the tracings of the deformed fingers.

For this graphic presentation the only materials necessary are: the lead tape, pencil, or colored pencils if so desired, and paper. The lead tape used is about 10 centimeters long and 4 millimeters thick. In consequence of its malleability, the tape conforms exactly to the shape of the deformed finger.

The curved tape which represents the deformed finger is placed on a sheet of paper which has the outline of the normal finger, and a tracing is made along the line of the tape. Either colored pencils or one of the broken lines are used to record the improvement on the different dates of the examination.

For the purpose of demonstration I quote the following case:

June 8, 1918, Mr. A. was referred to me by Dr. B. to restore function in the right hand. Patient sustained a severe injury of the hand. February 7: Contusion and lacerations of the third and fourth fingers, fracture of the middle and distal phalanges of the third finger, and wounds on the dorsum of the hand were present. Amputation of the fractured phalanges was performed when first aid was applied. Infection set in the stump and lymphangitis and tenosynovitis in the hand and forearm. The patient has stiff fingers and wrist, atrophy of the muscles of the forearm and limitation of motion in the elbow-joint. Physiotherapy was instituted. Treatment was begun June 7 and was ended July 20, 1918, when the patient was discharged able to return to work. The charts represent the fourth finger only, and are to serve as an example of this method of graphic presentation of finger deformities.

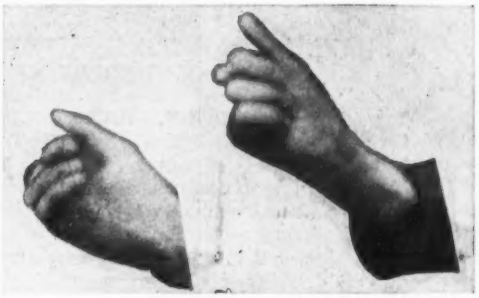


Fig. 3. Active flexion June 8, 1918; active flexion July 20, 1918.

These goniograms have been useful in reporting the improvement which has been gained in the course of treatment to the surgeon who has referred the patient to me.

A carbon copy of the chart is sent to the surgeon as often as required. If it is desired to report the improvement from date to date in figures of degrees, it is easy to designate the angle by means of a fleximeter. For the metacarpophalangeal joint, the arms of the fleximeter are placed on the lines corresponding to the metacarpal and the phalanx on the chart; this will give the angle of the metacarpophalangeal joint. To express in degrees the angle formed by one of the phalangeal joints, one arm is placed on a line corresponding to one phalanx, while the other on a line parallel to that of the next date. The angle is read off on the dial of the instrument when the arms are in their proper places. By means of the goniogram one is able to report the amplitude of movement in each joint very accurately. Measure by means of the tape the maximum of flexion, active and passive, of the joint; trace these corresponding lines on paper; measure the maximum of extension and trace these lines on the same paper, so that the lines which represent the distal surface of the joint should overlie. The angles thus formed are the angles of active or passive motion of the joint.

This same method can be used for the measurement of motion in the other joints of the skeleton with the same exactness, and it is preferable to a photographic reproduction and to records obtained by the goniogram of fleximeter.

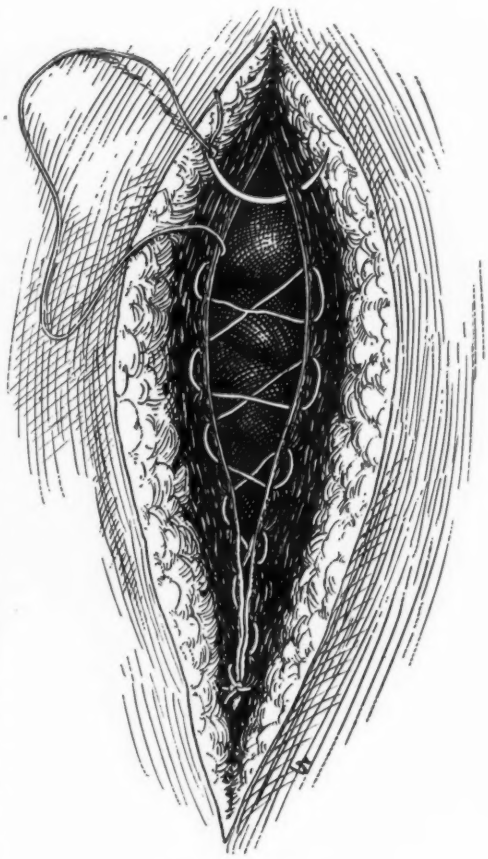
A SIMPLE, EFFECTIVE SUTURE FOR CLOSURE OF DIFFICULT PERITONEAL INCISIONS

By JABEZ N. JACKSON, M.D., F.A.C.S., Kansas City, Missouri
Chief Surgeon, Christian Church Hospital

THE closure of peritoneal incisions is at times a matter of much difficulty. This may be due in instances to tension resulting from muscle retraction, and in other instances is due to thinness and friability of the peritoneum itself. This is particularly true in incisions of the upper abdomen. Many more or less complicated suture methods and devices to overcome these obstacles have been suggested. We have tried most of them with varying degrees of dissatisfaction.

About three years ago rather accidentally, we fell into the use of a cross-buck mattress suture. It is exceedingly simple and has proved altogether satisfactory. We do not see anything especially new in it, though we have never seen suggested its use in this service. However, in view of the extreme satisfaction it has given us, we feel justified in calling it to the attention of others.

First, a simple transverse suture at the lower (or upper) end of the wound is tied. It is a continuous suture. The needle on the long end of the suture is now introduced from without inward about one-eighth to one-quarter inch above the primary suture. It passes obliquely forward and is brought from within outward, at a point about the same distance forward of the point of entrance. It is now brought backward to a point opposite the beginning and introduced on the opposite side from without inward. Again, obliquely it is advanced and brought from within outward one eighth to one-quarter inch forward of the beginning point of introduction. It is now drawn taut and the next stitch begun. It is thus an X or cross-buck mattress stitch. Where there is much tension or a very friable peritoneum a liberal bite of muscle may be taken in each stitch. When each stitch is drawn taut it is remarkable that it does not cut out. The peritoneum is also everted leaving no raw surfaces on the inside.



Cross mattress suture.

A METHOD FOR MARKING OUT VARICOSE VEINS FOR OPERATION

By GEORGE P. COOPERNAIL
Major, M. C., U. S. A., U. S. A. General Hospital No. 9, Lakewood, New Jersey

IN the operation for removal of varicose veins of the legs, the enlarged veins can be much more easily found if they are marked out on the skin previous to the operation, the patient standing, and sometimes it is well to cord the leg, but not too tightly, in order to distend the veins. When the patient is lying down and under an anæsthetic, the veins are more or less collapsed and in some cases, where there is much subcutaneous fat, it is quite difficult to find them. The operation most commonly performed today probably is the Mayo stripping operation and resection of veins that cannot be stripped. In the Schede operation the marking of veins would be of no special value, but this operation at the present time has become obsolete. Up to a few years ago, I marked them out with a 2 per cent solution of silver nitrate, which leaves a black mark over the veins, but if the skin is painted with iodine, at the time of operation, it is not very distinguishable.

I have had several accidents with the use of solution of nitrate of silver in the hands of internes, as it does not blacken the skin at once after it is painted on. The internes thinking the solution would not make a mark, proceeded to mark them out with a nitrate of silver pencil, the result being disagreeable burns. Several of my surgical friends have had a similar experience. The idea occurred to me of finding some other way of marking after these accidents. After trying out many of the colors and dyes, I found brilliant green, an analine dye, in an aqueous solution most satisfactory.

The veins should be marked out the day before operation and let dry before the clothing touches them. And at the time of operation they can be painted with one or two coats of iodine. The vessels will show beautifully through the coats of iodine, as green intensifies almost all colors. After the skin has been marked with the green, it is almost impossible to wash it off with alcohol, turpentine, ether, etc. It takes several weeks for the stain to wear off.

There are a number of distinct advantages in marking out the veins for operation. You can readily locate all the vessels and save much time searching for them. It enables one to perform a more thorough operation, removing all enlarged and tortuous vessels. With the vessels marked out it is possible to follow them with parallel incision, which will give you better access to adherent and tortuous vessels. Following the parallel incision there will be less scar. Most operators make the transverse incision in order to locate the vessels more readily.

I cannot recommend this method of marking varicose veins too highly, and I am sure that if tried it will be found satisfactory.

Captain T. D. Buchanan, Medical Corps, after seeing a number of cases operated on by this method suggested that it would be a good way for marking the scalp in intracranial operations.

CORRESPONDENCE

FULL-TERM ECTOPIC PREGNANCY

To the Editor: I am submitting the following case history on account of its rarity and the unusual length of time before delivery.

Mrs. B.,age 35, second pregnancy. Two years ago the patient had a miscarriage at 5 months. She has always been well. Her last menstrual period began February 9, 1918. Since that time she has been well and has not suffered from nausea or vomiting. She has never had a vaginal discharge or any signs of bleeding.

The patient was first seen, May 19, 1918, at which time her heart and lungs were negative. Vaginal examination showed the cervix slightly softened and the uterus seemed to be pushed to the left side. She was not seen again until the latter part of September, when she was having considerable indefinite abdominal pain, which made it impossible for her to lie on her back without intense pain. Vaginal examination did not show any presenting part. Abdominal palpation showed the fœtus in the transverse position.

On November 9, the patient had a few pains and passed a small mass about the size of a lemon. This was not seen as it was not saved for examination. She was advised to enter the hospital but refused to go. She was quite comfortable, from this time until the first of January, 1919, when she had a severe attack of vomiting. Fœtal movements were present. The urine was negative. Finally the last week in January she consented to go to the hospital for operative treatment.

January 30, 1919. The patient was in fairly good condition. She was able to walk without very much discomfort. X-ray examination of the abdomen showed the fœtal head just above the rim of the pelvis on the left side. The buttocks were above the umbilicus. The cervix was small and retracted.

On February, 1, 1919, under ether anæsthesia, a midline incision about 7 inches in length was made. The sac was found adherent to the peritoneum. The adhesions were separated and the sac delivered. The sigmoid was adherent and spread over the upper portion of the sac. The sac was opened and a well-formed baby, weighing 8 pounds was delivered. All the blood sinuses were closed and there was very little bleeding.

The sigmoid and ureter were then separated from the sac with a great deal of difficulty and the mass removed from the left horn of the uterus. A small portion of the fundus of the uterus was removed which was repaired with several catgut sutures. The wound was closed by layers with catgut, silkworm, and silk. No drainage.

The patient made a good recovery and 6 weeks later walked a mile to the office without any discomfort.

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HÆMOLYTIC STREPTOCOCCUS AND INFLUENZA IN LABRADOR

To the Editor: Since reading an article in SURGERY, GYNECOLOGY AND OBSTETRICS on the delivery through cæsarean section of a living child after the death of the mother, it occurred to me that the following might be of interest. A very urgent request came to me the other day, in this country where cows are so very rare, to look at a dying beast. I found the cow so far as I could tell, dying. It was riddled with tuberculosis, for the week past had not been able to stand, and it appeared to be suffering a great deal, so I ordered it to be killed at once. This was done by shooting it through the forehead twice. It lay over dead, and after the lapse of a minute or so I opened the belly to try to save the calf. This proved entirely successful, the calf only needing a little stimulation to breathe. To my surprise however, I found after reviving the first, that the uterus contained a second calf, which owing to the small space and semi-darkness I had not noticed before. This calf was also removed and revived. This is now over a month ago, and both are now thriving well, and likely to be good healthy animals, as they have never taken milk from their dam.

The epidemic of influenza in Labrador has been so serious as nearly to wipe out the population, especially the Eskimo and Indians. I have no detailed reports yet from our most northerly hospital, except that hundreds have died. If the hæmolytic streptococcus is the determining factor, then it cannot be that in these cases it has been carried in milk, which I see one of your contributors states, for there is not a single cow on that coast, and none of the natives uses milk.

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